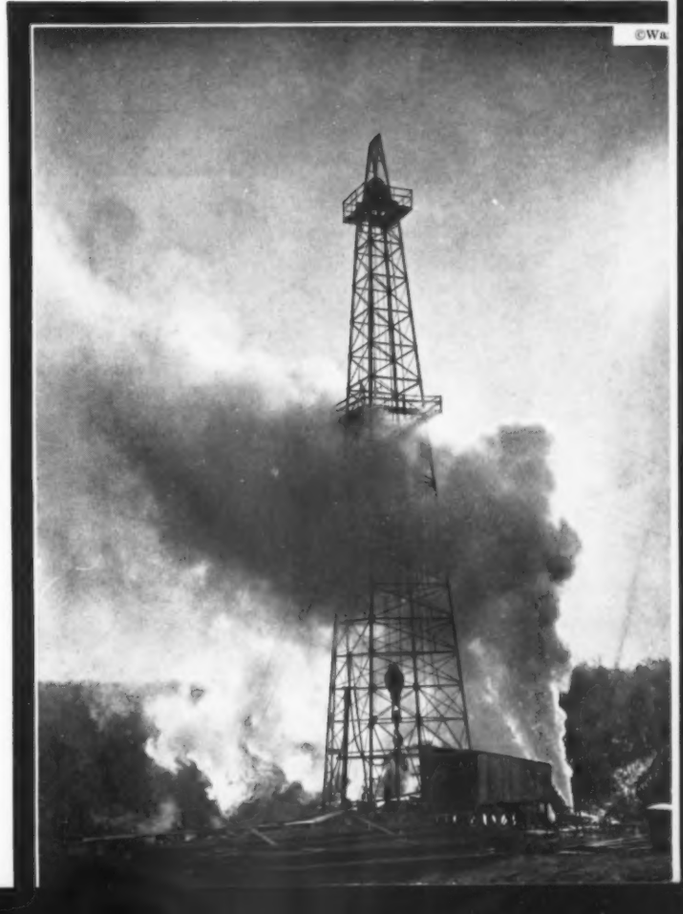
NEW YORK • # WORLD PETROLEUM • LONDON

Socialistic Tendencies of U. S. Administration Clearly Revealed As Threat to Present Organization of Industry • Financial Results in First Quarter Show Improvement • Oil Companies Expand Eastern Venezuelan Holdings • The Trend in Production Research Indicated by Professor Uren



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SEPTEMBER
1935

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VOLUME VI — **Editor, E. W. Mayo** — NUMBER 9

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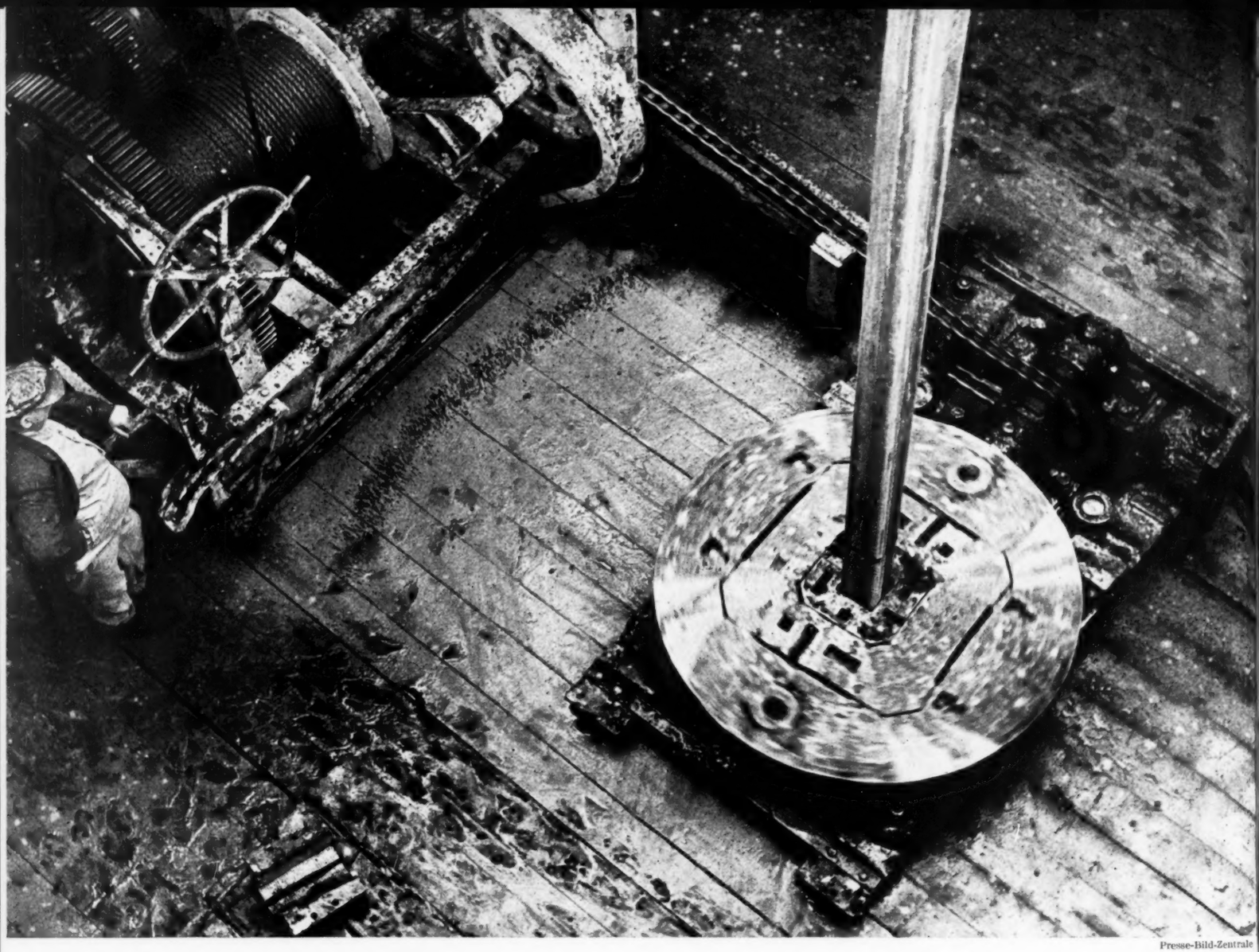

Presse-Bild-Zentrale

Rotary table spinning the bit deeper and deeper into the earth in Germany's concentrated search for additional petroleum reserves.

NEW YORK • WORLD • LONDON

PETROLEUM

Administration's Business Policy

BECAUSE the policies of the Roosevelt administration contemplate profound alterations in the organization and operation of business in the United States they are a proper topic of discussion for a business journal. Until recently these policies, or rather the plans for their consummation, have been only vaguely known, but with the measures put forward at the latest session of Congress, and particularly in view of the proposals for which the President has made a determined drive during the past three months, they have been made much more clear.

Based on the utterances of the President himself and the arguments advanced in Congress in support of legislation that he has actively favored it is a fair statement that the Roosevelt program has the following industrial objectives: the breaking up of large business organizations and the destruction of large fortunes; gradual extension of governmental direction of industry, the government itself entering into direct competition with private capital in certain lines; establishment of a labor hierarchy, making unions a separate and specially favored class; granting control over the credit resources of the country to a politically appointed federal body; nationalization of the large group of industries which have to do with natural resources.

Mere statement of these proposals shows that their adoption would effect radical changes in the fundamental basis of American business as it has existed heretofore and ultimately would substitute the will of the State (that is to say of the dominant political group) for private initiative as the fundamental factor directing all business. This is made more evident by examination of details of some of the proposed legislation.

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Crushing Big Organizations

THOUGH designated as a tax measure the bill recently thrust upon Congress with demand for its immediate adoption, placing progressive imposts upon inheritances and earnings according to their size, admittedly is not designed primarily to produce revenue but rather to eliminate large businesses and to dissipate large personal fortunes. Enthusiastically heralded as a "soak the rich" project, it has been revealed on closer inspection as a proposal which would penalize all that large army of small investors whose savings have been put into corporate securities. It would lessen the opportunities for employment and in the course of time would throw many enterprises into the hands of the government.

Bigness in itself never before has been stigmatized as a crime in any civilized nation. In fact it has been the pride and boast of the modern age. The rise in living standards which has been carried further in the United States than in most other countries has been due primarily to the cheapening of products through the standardization of methods which is the basis of that mass production hailed as the distinctively American contribution to industrial progress. When coaches were built to order by a few skilled workmen only the well-to-do could ride, but with motor vehicles turned out by the thousand in identical pattern, mainly by automatic machinery, from plants in which millions of dollars have been invested, even the poorest artisan can drive his own car. Confiscation by taxation of all big businesses and of the aggregations of private capital that make possible large scale operations would not help the small man, but it would tend to force large organizations into the hands of the state and to create inevitably a condition of state socialism.

▼

Political Banking

PERSISTENT efforts to change the mechanism of banking regulation indicates a definite purpose to bring this most important part of the business structure under the domination of the executive branch of the government. It is necessary only to look at the unfortunate experience of this and other nations with partisan management of banking in the past, notably its contribution to the disastrous panic of 1837, to realize the danger of permitting a politically apppointed and politically minded federal board to regulate the supply of credit which is the life stream of commerce. It is not of record that any federal administration ever has attempted to restrain the undue expansion of credit and it is hardly conceivable that a group of political appointees would venture upon a step so unpopular.

Perversion of banking practice in order to accommodate a rising flood of government securities is a condition that exists even now. With the banking system under the thumb of executive authority there would be no check upon the extension of this practice nor any safeguard against pressure to favor one section or one branch of industry to the detriment of others. The banking resources of the country belong to the depositors. A government that attempted to divert them to its own purposes

and to sustaining its pet theories would be practicing a gross form of despotism.

One of the disquieting spectacles presented at Washington in the past two years has been the constant juggling with the financial system in the course of which citizens have been deprived of their property, their contracts with the government itself repudiated and redress through legal means denied them. Confidence in the stability of the currency, a primary requisite of normal business activity, has been undermined, not only by the acts of the Administration but by the encouragement given to a succession of financial medicine men who promised by the exercise of their monetary magic to recapture a vanished prosperity.

▼

Government Management

NEARLY all the conspicuous cases in which the Administration has attempted to influence legislation affecting business have been characterized by the effort to extend the web of federal domination over successive fields of industry. The malevolence toward certain businesses which has found expression in the demand for the destruction of all holding companies and in the direct competition of the government itself with utilities controlled by private capital may be an expression of personal idiosyncrasy, but this does not apply to attempts to determine what the farmer shall grow or to dictate the relations of employer and employee.

Among some at least of those who have supplied the intellectual leadership for the New Deal it is frankly acknowledged that government regulation of business will not attain their ends but that direct government participation in management is sought for. Perhaps no other single measure affords a better illustration of the application of this view than the Guffey coal bill which was included among those on the so-called "must" list of the Administration. If enacted into law it would deprive the owners and operators of coal mines of practically all initiative. Their output would be fixed by a national board, the price at which they could sell and the wages which they would be required to pay would be determined for them. Their product would be taxed, not to provide revenue for the government but to limit output by retiring from operation so-called marginal mines. Its final result could hardly be other than government ownership and operation of coal mines.

Among the more advanced New Dealers no secret is made of the purpose to extend similar treatment to all natural resource industries including lumber, petroleum and the production and distribution of power. Those who are connected with any of these industries may profitably study the terms of the Guffey bill and consider whether they would care to have them applied to their own particular occupations.

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Disregard of Constitution

IT IS significant of the purpose and methods of those who would remake the form of government and revolutionize the long established organization of business that the measures depended upon to accomplish these results are being pressed despite plain warnings that they are unconstitutional. When the President himself urges legislators not to withhold support from a bill because of doubts, however reasonable, as to its constitutionality it indicates either an attitude of contempt toward the co-equal judicial branch of the government or a desire to place the supreme law-interpreting power in the light of being an obstacle to social progress.

The right of any citizen to disapprove the existing form of government and to seek by legal means to change it is unquestioned but no one branch of the government has any right to disregard or seek to overweigh another. Certainly the Congress is derelict in its duty if it enacts measures that its members know to be violative of the Constitution which they have promised by oath to sustain and thereby places upon the Judiciary the onus and responsibility for remedying the indifference and cowardice of the legislators. There is scarcely one of the pet measures urged upon Congress by the Administration in recent months which has not been challenged by competent legal opinion as unconstitutional.

▼

Time for Thinking

THESE are not political questions. They have nothing to do with ordinary partisan issues. No political party ever has advocated in its platform the projects and policies embodied in the legislative measures referred to above that have been spoon fed to Congress during the session now ending. The people of the United States never have given a mandate for changing the underlying business structure of the country. Indeed they never have had the opportunity to pass on the proposals that have been fought over in Washington so clamorously in recent months.

The matters to which we have referred are matters primarily affecting the welfare and livelihood of all those engaged in private occupations as distinguished from employment in the public service. Every man has the right to defend his business (so it be an honest one) against destruction as he defends his home against marauders. When he is confronted by proposals for changing the entire relationship of government to industry he has the duty of examining their probable effect upon his own position and of resisting the usurpation of rights guaranteed him under the very charter of government. He even has the privilege of consulting his own desires as to whether he prefers to lay his own course and manage his own affairs according to his imperfect judgment or to have his every action directed from a centralized official bureau. The next twelve months is the time when he should consider and decide upon these questions.

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Fundamental Issue

WE HAVE gone far enough along the road of political experimentation to realize that the one certain heritage of the New Deal will be an impaired business organization and a burden of debt such as never before has encumbered the nation. Debt means taxes and taxes must be paid by business, not big business alone but the farmer, the office employee, the wage worker, the man who operates a gas station or a perambulating peanut stand. Only those can escape contribution who occupy the country's jails or live on the public dole.

There is a limit to the elasticity of public credit. If the inescapable task of balancing public income and outgo were undertaken at once the weight of taxation must still be heavier than in the past. The only source from which taxation can be met is the creation of wealth. The heavier the taking of the state from the total fund thus created the less there will be to supply the necessities and comforts of the population as a whole. If the means of creating wealth, which is business, is itself put under bondage to the state the total fund will be still further lessened, the income, real income, of the average citizen will be reduced and the standard of living lowered. No greater issue is before the American people today than the rescue of business from the reaching hand of politico-governmental control.

Company Earnings Rise in Second Quarter

Financial Reports of Representative American Oil Corporations Show Best Results Since Start of Depression — Heavy Motor Fuel Demand and Stable Market Aid Showing.

SO FAR as conclusions may be drawn from the limited number of oil companies that publish quarterly reports of operations the second quarter of 1935 was marked by a great improvement over the first three months of the year from the standpoint of earnings and in fact was one of the most profitable quarterly periods in recent years. The second quarter of the year usually shows better operating results than the first quarter owing to the greater demand for products. This year, however, the showing for the three months April–June reveals marked improvement over the corresponding period of 1934 and of course is far better than the same months in 1933.

A primary explanation of enhanced earnings for American petroleum companies is to be found in the remarkable growth in motor fuel consumption. Statistics of the U. S. Bureau of Mines provide some interesting comparisons on this point. For the half year ending June 30, 1935 domestic demand for gasoline amounted to 199,540,000 bbl. or an average of 1,093,370 bbl. daily as compared with 192,164,000 bbl. or an average of 1,052,950 daily for the corresponding period last year. This is a gain of 3.8 percent or an increase of over 7,000,000 bbl. for the six months period.

In the second quarter of 1935, however, motor fuel demand rose to record proportions. For the three months April–June it amounted to 113,049,000 bbl. or 1,242,000 bbl. daily. This was an increase of 5,877,000 bbl. or 5.5 percent over the corresponding period of 1934. Furthermore, it was the largest consumption ever recorded for this portion of the year, exceeding by nearly four percent that of the second quarter of 1931 which has stood as the peak year previously. Uncertainty regarding the renewal of the federal gasoline tax tended to cause distributors to limit their stocks to actual requirements in June 1935 so that the figures of distribution represent undoubtedly a close approximation to actual consumption.

While the demand for petroleum products has risen to new heights, providing a record volume of business, there has been a gratifying absence of price wars and underselling competition thus far during the current year. While there have been sporadic cases of such troubles they have been confined for the most part to local areas. The price of crude has been maintained at approximately the same level at which it has stood for the past two years while the price of gasoline has been slightly above the average of these former years and has enabled those companies that depend upon refining and marketing for their earnings to make a better relative showing than before as compared with those that confine themselves principally to production.

In the accompanying table half-yearly results for 1934 and 1935 are stated for sixteen representative companies operating in different parts of the United States. Wherever the figures for quarterly periods are available these are given. In some cases special factors have intervened to cause an abnormal fluctuation in the figures of one or another quarter but in general the trend toward more adequate earnings is clearly marked. Continuation of the heavy demand for motor fuel during the third quarter is practically certain. With the maintenance of relatively stable market prices, 1935 should be the most profitable operating year for petroleum companies since the beginning of the world depression.

Striking contrasts appear in some of the company showings such as the transformation of a 1934 deficit of over $900,000 into a profit of half a million in the case of Shell Union, the gain of 44 percent in the net income of Standard Oil

Financial Showing of Sixteen United States Oil Companies 1934-1935

	Net Income 1935			Net Income 1934			Earnings per share	
	First Quarter	Second Quarter	Six Months	First Quarter	Second Quarter	Six Months	1935	1934
Amerada	$399,310	$419,024	$818,334	$525,000	$496,457	$1,021,457	$1.04	$1.33
Atlantic Refining Co.	D129,000	384,000	255,000	623,000	2,367,518	2,990,578	.10	1.12
Continental Oil Co.	940,807	2,192,889	3,133,696	1,211,483	1,165,829	2,377,312	.64	.51
Mid-Continent Pet. Co.	D273,057	778,397	505,340	310,031	791,858	1,101,889	.27	.59
North American Oil Consol.	.....	.....	143,932	.....	.....	147,424	.52	.53
Ohio Oil Co.	622,150	1,712,654	2,334,804	1,416,326	1,990,182	3,406,508	.10	.26
Phillips Pet. Co.	1,542,335	3,477,640	5,019,975	726,125	1,784,033	2,510,158	1.21	.60
Pure Oil Co.	.....	.....	3,400,000[3]	.....	.....	.....[3]	.79	...
Seaboard Oil Co.	439,177	408,814	847,991	368,219	374,576	742,795	.68	.59
Shell Union Oil Co.	D1,121,040	1,649,775	528,735	.....	.....	D938,683	...	...
Standard Oil of Calif.	5,891,022	5,692,120	10,583,142	3,318,591	4,012,243	7,330,834	.81	.56
Standard Oil (Indiana)	.....	.....	13,191,166[1]	.....	.....	.....[2]	.87[1]	...
Sun Oil Co.	.....	.....	3,157,863	.....	.....	3,818,018	1.52	2.08
Superior Oil Co.	81,561	73,130	154,691	74,594	74,433	149,027	..	...
Tidewater-Associated Oil Co.	1,220,991	2,146,462	3,367,453	1,430,962	1,247,423	2,678,385	.26	.14
Union Oil Co.	1,350,000	1,600,000	2,950,000	500,000	D200,000	300,000	.36	.07

[1] Accounting system changed, amortizing cost of drilling over life of well; by the former system (for comparative purposes) net for first half of 1935 would be $10,893,538 or 72 cents per share.

[2] No half year report issued.

[3] Approximate; (estimate by Pure Oil Co.)

Company of California and the rise of Union Oil Company's net from $300,000 to $1,600,000. The report of Phillips Petroleum Company is perhaps more typical than any of these. The Phillips Company doubled its net profit in spite of a rise of $1,000,000 in operating costs, due mainly to higher monthly and hourly wage rates, by reason of a ten percent increase in gross income.

While the present securities law effectively discourages new capital issues a number of oil companies have taken advantage of prevailing low interest rates to retire or refund their bond issues or other outstanding indebtedness. Recent large operations of this kind were put through by Pure Oil Company and Consolidated Oil Corporation. These changes have not yet been reflected in financial reports but through a reduction of fixed charges they will substantially improve the position of companies that have had large bond issues outstanding and are in the fortunate position of being able to convert them.

▼

New Code Drafted for U. S. Marketers

WORKING steadily for two months following the decision of the Supreme Court which declared the National Industrial Recovery Act unconstitutional a group of representative members of the United States oil industry has prepared a tentative code for the marketing branch of the industry which is intended as a substitute for the marketing code set up under the NRA.

The task has been carried on by the members of the marketing sub-committee of the late Planning and Coordination Committee under the chairmanship of Charles E. Arnott, vice president of Socony-Vacuum Oil Company, Inc. They have been assisted by a number of other oil men who were invited to participate in the work in order to make the drafting committee representative of all parts of the industry.

As a basis for the proposed code the committee used the rules of fair practice adopted in 1931 with the approval of the Federal Trade Commission which was signed at that time by some 16,000 marketers. Certain features, including the whole section relating to credit terms, were borrowed from the NRA code and a few new points not in either of the previous sets of regulations were incorporated.

Final draft of the proposed code as agreed upon by the committee in charge was placed before the Directors of the American Petroleum Institute on August 1 and through that organization is being submitted to members of the marketing branch of the industry for consideration and action. If it receives the support of the marketers at meetings of local groups which are to be held throughout the country it will be returned to the Institute for reconsideration and then will be submitted to the Federal Trade Commission for final authorization. Since its main provisions follow rather closely the lines previously laid down by the Commission in connection with other trade agreements it is assumed that the Commission's approval will be given.

In general the new code is much shorter and simpler than the one adopted by the Oil Administration under authority of the National Industrial Recovery Act which never was fully effective. It contains no provision for price fixing which, of course, would not be authorized under present conditions. It does require that dealers shall post their prices and adhere to the posted list without discrimination between purchasers. It forbids the gift, loan, or lease of equipment and accessories to retail distributors and the use of premiums or lotteries to promote sales. It prohibits false and fraudulent claims in advertising and the imitation or unauthorized use of company equipment. Sales below cost for the purpose of injuring a competitor are banned. Exempted from code regulations are transactions between refining companies, between parent companies and their subsidiaries and sales amounting to more than 25,000,000 gal. yearly.

Regulations of the code relating to prices are as follows:

Rule 1—Each vendor of naptha, gasoline, motor fuel, tractor fuel, kerosene, range oil, heating oil and motor oil shall determine for himself the prices at which he desires to sell each of such petroleum products, and having determined such prices he shall post them at the place hereinafter provided and each price shall remain posted until a new price has been determined and posted.

The prices to be posted shall include the prices applicable to all classes, types, methods and quantities of delivery and to all classes of buyers. The posting shall contain all terms of sale including discounts and credit terms offered and freight rates and delivery costs to be charged or allowed to the purchaser.

The prices for all deliveries from service stations and the prices for deliveries in packages, whether furnished by the seller or buyer, and in tank wagons or trucks from bulk plants shall be posted at the place from which the delivery is made. The prices for all other deliveries shall be posted at the place from which the delivery is made but seller may, at his option, as a regular practice, post them at another place within the same state, provided he posts at the place from which deliveries are made a notice stating the office of the vendor at which the prices therefor are posted. All prices shall be posted at places readily accessible to the public during usual business hours. For five days, exclusive of Saturdays, Sundays and holidays, after prices are posted, and for a like period after deliveries at such posted prices are commenced, records of such posted prices shall be available to any inquirer at the place where they were posted.

All sales, other than sales pursuant to bids required by law to be sealed, and other than sales for delivery in tank car, barge or cargo, or by tank truck into a bulk storage plant fully equipped to receive deliveries directly from barges or tank cars, shall be made at the posted price applicable at the time of sale or at the time the contract to sell is made. When sales are made for delivery in tank car, barge or cargo, or by tank truck into a bulk storage plant fully equipped to receive deliveries directly from barges or tank cars, the price thereof shall be posted immediately upon the execution of the contract, or acceptance of order, and shall remain posted for 24 hours exclusive of Saturdays, Sundays and holidays. When bids are made which are required by law to be sealed, such bids shall be posted immediately after the time specified for their opening and shall remain posted for 24 hours exclusive of Saturdays, Sundays and holidays.

No sales shall be made unless the prices thereof are posted in accordance with the provisions of this rule.

No rebates, allowances, concessions or benefits shall be allowed in any manner so as to permit any buyer to obtain petroleum products at a net lower cost than the posted price applicable at the time of the sale or at the time the contract to sell is made.

Rule 2—Coupon books or other scrip of any nature, if used, shall be sold and redeemed at their face value without any discount.

Rule 3—The selling of goods below cost with the intent and with the effect of injuring a competitor and where the effect may be to substantially lessen competition, or tend to create a monopoly or to unreasonably restrain trade, is an unfair trade practice.

In a statement given out at the time when the proposed code was made public Chairman Arnott said:

We are trying to draft a code for the entire marketing branch of the petroleum industry, and we hope that, at the proposed meetings to be held throughout the country beginning in September, all petroleum marketers will express their opinions, make their recommendations, and finally approve a code. With these meetings ended, and every marketer heard from, the draft will be re-

turned to the Institute's board for final consideration, and then will be placed before the Federal Trade Commission at Washington, D. C., with a request for final approval.

The draft of the code to be placed before the industry is preceded by a copy of a resolution adopted recently by the Institute's board explaining that the "Board of Directors of the American Petroleum Institute submits to the petroleum industry for study and consideration the following rules as prepared by the committee, it being understood that after due study and consideration of said rules by the industry, the committee shall resubmit its final recommendations to this board for its further consideration and action."

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Companies Extend Holdings in Venezuela

Impressed by the Inevitable Decline of Large Flush Production within the United States, International Oil Companies Seek to Build up Reserves Elsewhere.

By C. N. Clark

CARACAS, AUGUST

SINCE the beginning of the present year there has been a rapid and uninterrupted competition on the part of the American petroleum companies in the acquisition of additional acreage in Venezuela. It would appear that estimates recently published respecting the probable speedy exhaustion of reserves of oil in the United States, failing the discovery of new fields, have been taken so seriously by many of the American companies that they are hastening to provide for such a contingency by acquiring further concessions in what is today the most promising source of renewed supplies in the western hemisphere.

With the exception of the ample concessions held by the Royal Dutch-Shell group, and the minor holdings of the British Controlled Oilfields Limited, the North Venezuela Petroleum Company and a few lesser European interests, most of the known and probable oil areas of Venezuela have been acquired by American companies. At the present time, not to name sundry smaller interests, the following well known companies are registered and possess important petroleum concessions within the country: Standard of New Jersey, Socony-Vacuum, Standard Oil of California, The Texas Company, Pure Oil, Gulf of Venezuela, Venezuelan Petroleum (Sinclair), Pantepec and the Caracas Petroleum Company. Moreover, competition is practically limited to the American companies. The Anglo-Iranian cannot acquire Venezuelan holdings, either directly, or indirectly through the Burmah company, by reason of its partial ownership by the government of Great Britain. Efforts to do so have lately proved ineffective.

Recent Acquisitions

IN ADDITION to its very large acquisitions of last year, the Standard Oil Company of Venezuela has acquired since January 1, 1935, 653,850 hectares of new concessions; the Venezuelan Gulf Oil Company has likewise acquired within the same term 830,836 hectares of new holdings; and the Socony-Vacuum Oil Company, although a new-comer, has obtained 163,633 hectares of concessions. The greater part of all these acquisitions has been obtained by purchase from other companies or from individual owners, but a very considerable portion was secured by purchase from the government, either from the national reserves or the free lands available for disposition by the government.

Standard of Venezuela

OF THIS company's acquisitions of 653,850 hectares, 32,599 hectares were bought from the government's national reserves, and 17,565 hectares were grants of concessions from the free lands. Purchases from the national reserves were paid for at the rate of 30 bolivares (approximately $7.50) per hectare, or a total of B^s.977,962. ($244,490). That is, these were bought at double the minimum legal initial surface charge, in addition to which the holder must pay from four to eight bolivars per hectare throughout the term of the grant, plus 15 percent of the commercial value of the product at the point of shipment. For its grant of 17,565 hectares for exploitation, from the free lands, the company paid at the rate of B^s.25. per hectare, amounting to B^s.439,125. (approximately $109,781) and must pay the further legal charge of 12½ percent of the value of the product.

Recent Regional Aquisitions by American Companies in Venezuela

(Hectares: 1 hectare = 2.47 acres)

Companies	Anzoátegui	Monagas	Guarico	Delta Ter'y	Total
Standard of Venezuela	329,382	103,784	122,463	98,221	653,850
Venezuela Gulf Oil Co.	557,033	143,803	130,000	.....	830,836
Socony-Vacuum Oil Co	124,963	30,343	8,327	.....	163,633
	1,011,378	277,930	260,790	98,221	1,648,319

Type of Concessions Recently Aquired by American Companies in Venezuela

(Hectares)

Companies	Exploration	Exploitation	Nat'l. Res'vs	Total
Standard of Venezuela	493,896	95,581	66,373	653,850
Venezuela Gulf Oil Co.	745,810	49,596	35,430	830,836
Socony-Vacuum Oil Co.	153,290	3,187	7,156	163,633
	1,392,996	146,364	108,959	1,648,319

© Wide World

Three principal suburbs of Baku, incorporated under the name of the communist hero Chaumian, who died on the barricades of the October Revolution, are Chornigorod (Black Town), Beligora (White Town), and "Thirty Commissars." Bright new homes for the workers in Beligora are here shown replacing the ancient soot-stained shacks —while in the background the oil wells of Baku work night and day to support the industrial hopes of the Soviet Union.

These free land concessions numbered 40 and it is believed that the company, which has applied for large additional grants since July 1, may obtain several hundred additional concessions in the state of Anzoátegui, from the free lands and national reserves.

These figures, which appear very high, in view of the fact that the areas acquired cover lands as yet almost unproved as sources of petroleum, afford an idea of the unusual interest of American companies in increasing their Venezuelan holdings. Above will be found a tabular statement of the Standard's acquisitions up to July 1.

Venezuelan Gulf

THIS company has been no less active than the Standard of New Jersey in the extension of its acreage in Venezuela. Up to July 1 it had acquired 850,836 hectares, of which 35,430 were purchases from the government's national reserves. The company has been endeavoring to secure the national reserves within the zones of its prior acquisitions, but hitherto without success. It may be noted that the Gulf and the Standard of New Jersey were the only companies to obtain concessions from the government. New acquisitions are shown in the tabulation.

Socony-Vacuum

ALTHOUGH this company did not enter the Venezuelan field until 1934, it has been as actively interested in increasing its holdings as have the two companies already named. All of its 163,633 hectares were acquired from prior grantees. This company was likewise interested in obtaining substantial concessions from the national reserves of the government, but it did not succeed in accomplishing this. The tables appended hereto give the extent and location of the company's acquisitions during the current year.

Venezuelan Petroleum Company

THIS company (affiliated with the Sinclair interests), long established within Venezuela, possessing concessions located principally in the interior southerly states of Apure and Zamora, has recently undertaken the acquisition of additional acreage, having purchased 120,000 hectares, covering some 12 concessions in the state of Zamora, from a private owner. The purchase price is understood to have been about four bolivars per hectare.

The Venezuelan state of Anzoátegui borders the Caribbean sea on the north coast, in the easterly region of the republic. The state of Monagas lies far to the east and borders the gulf of Paria. The state of Guárico lies in the east central region, the Orinoco being its southern boundary. The Delta territory lies east of Monagas, between it and the Atlantic ocean. All the newer acquisitions above described are situated, therefore, in what is termed the "Oriente" of the republic.

Petroleum Production From Venezuela
May 1935
(Barrels)

Company	Production
Lago Petroleum Corporation	3,733,372
Standard Oil Company of Venezuela	2,117,091
Venezuelan Oil Concessions Ltd.	4,435,159
Caribbean Petroleum Company	218,216
Colon Development Company Ltd.	60,158
Venezuelan Gulf Oil Company	1,897,541
British Controlled Oilfields Ltd.	76,223
Total	12,537,760

Senate Rejects Federal Oil Control

Bill Making Hot Oil Control Permanent, Limiting Imports and Approving Interstate Compact Passed by Senate and Considered Victory for Federal Control Opponents. By Don Kirkley

WASHINGTON, AUG. 20.

SUDDEN shifts of position marked the checkered course of oil legislation in Congress this month. First of all was the message of the President following a conference of legislators and members of the Administration. This message, contrary to expectations in many quarters, was confined to a request for authorization of an interstate compact for the regulation of production, specifically in the interest of preventing waste.

Following this came the long-awaited report of the Cole sub-committee of the House Interstate Commerce Committee and the introduction by Representative Cole of a bill intended to replace the Thomas bill which faced the opposition of politically powerful elements in both branches of Congress. The Cole bill was accepted by both Representative Disney and Senator Thomas, authors of bills that had been pending since early in the session, Senator Thomas submitting a revised bill which differed from the Cole proposal mainly in providing that imports be limited to the daily average of the last months of 1932, the period used in the limitation under the NRA code while the Cole bill left this to the discretion of the President.

The Cole bill in its principal provisions proposed that legislation be enacted to:

(1) Ratify the Dallas interstate compact for restricting production to prevent physical waste and subsequently ratified by Texas, Oklahoma, Kansas, New Mexico, Illinois and Colorado.

(2) Create an independent Petroleum Administrative Board, to function as a research and fact-finding agency, and to inform the producing states of the estimated production necessary to meet demand.

(3) Authorize the President to transfer to this Board of five members, any other federal agency dealing with oil in any of its phases.

(4) Add clarifying amendments to the Connally hot oil law, vesting the Board with authority to administer it.

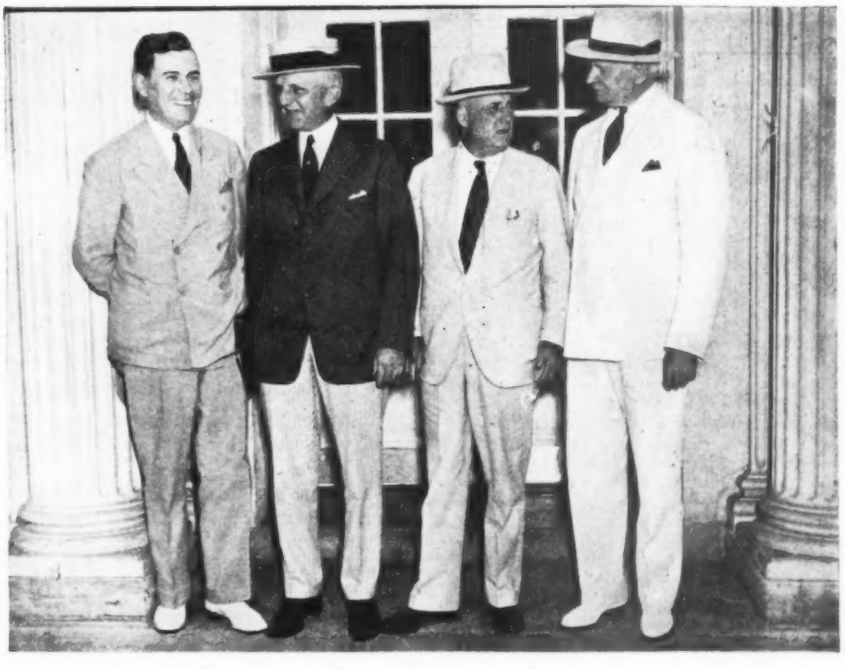
(5) Limit of imports by the Board and President as might be necessary to protect the domestic producers operating under curtailment regulations.

(6) Authorize voluntary agreements, not binding on non-signatories, and exempt from criminal provisions of the anti-trust laws, covering new pool development, refinery operations and wholesale marketing practices.

(7) Instruct the Board to report annually to Congress with recommendations for any legislation that it might deem advisable or necessary.

Supporting the bill as restricting federal intervention within the limits defined by Supreme Court decisions in the hot oil cases and the NRA case the Cole committee submitted a report in which it stated that the bill "includes all legislation necessary to meet the problem as it exists today and we hope for all time." The report included the following observations:

". . . the interstate compact . . . itself is not the strongest document of the kind that could be drawn, but it is an initial effort on the part of the oil-producing states to meet, in a constitutional way, the prevention of waste of this great resource and in that way the conservation thereof. The compact bespeaks an effort on the part of a number of states to meet a great problem which is peculiarly a state one and yet the magnitude of which flows over into every state of the Union, thereby making it one of real national interest. The right of the states to handle and control the production end of this industry is one that the committee recognized and wants to encourage. The problem is not too big for the states if they sincerely want to solve it; at the same time it is not one which will tolerate abandonment or trifling by the states. The country as a whole has the right to demand that petroleum, a great God-given resource belonging as a whole to no state or individual, but a natural national resource, must be conserved and must not be wasted. Petroleum has admittedly become an integral, indispensable part of almost every activity of our country, both private and public. It presents a problem which the committee recognizes as belonging in a large measure to the states for solution, but in order for the states to succeed in such an effort they must have the cooperative help of the federal government.



After a conference with the President, Representatives Disney of Oklahoma (left), Cole of Maryland and Rayburn of Texas leave the White House with Senator Thomas of Oklahoma (right). Congressmen Disney and Cole appear cheerful in the face of fading possibilities of federal oil control legislation at this session of Congress.

"If many other problems, involving production, peculiar to a known number of states, had been handled through the compact procedure as a real and genuine effort on the part of the interested states to solve such problem, and that, approved by Congress, much legislation heretofore passed by Congress dealing with production of many commodities would have been unnecessary. When Congress gives approval, however, to a compact of the type set forth in section 1 of this bill, giving to the principal oil-producing states control of production of petroleum, supplemental legislation is necessary and advisable to the extent included in this bill.

"The petroleum industry is our third largest industry, railroads and agriculture being the only two exceeding it in investment. Since the world war this industry has been the subject of ever-recurring investigation and study on the part of the federal government. President Coolidge sensed the importance of the President and Congress knowing at all times, if possible, the status of our petroleum reserves, and of the necessity for rigid waste prevention measures and in general, the preservation as long as might be possible, of a resource of almost immeasurable value, admittedly indispensable at this time to innumerable activities and yet of a limited quantity. President Hoover and President Roosevelt have likewise expressed their keen interest in a similar way. The quantity of petroleum in the country today is pretty well known and no one will deny that while there is more than is necessary to meet current demand it is shockingly low to meet future demand. New discoveries it is true will be made, but such new discoveries should be accompanied by a greater respect on the part of developers of such fields looking to ultimate recovery from such fields, or pools, than has been the experience of the past in the shocking conduct of operators in the larger fields of the country.

"Section 5 provides for regulation of imports and is quite similar in language to the import provisions of the recent amendments to the Agricultural Adjustment Act. It says, that the President, upon factual finding by the Board, shall limit importation of petroleum whenever it is found that the importation of petroleum, including natural asphalt, into the United States is in such quantities as to render ineffective, or materially interfere with the program undertaken in this act. That means in brief this: This bill sanctions production control by the states to the extent that such control can be regulated under waste-prevention statutes as a legal exercise of the police power of the states, and it is fair to the producing states that they should enjoy the market, or the maximum production the reserves of such states will permit so long as such production is in keeping with proper conservation laws. It is folly to say that the greatest ultimate yield of petroleum will be enjoyed by the producing states and come to the great consuming portion of this country for our own markets, if production is permitted under scientific engineering advice, so as not to include shocking waste such as we have known to exist in the past, and in the same breath say that there shall be no protection to the producing states from the markets of foreign countries. This is true conservation; and this is what is best for our country as a whole. The provisions work both ways. If there is an unnecessary curtailment, or if there is a curtailment of production below what should be produced then the importation of the product can be permitted to a larger extent than otherwise."

Put forward as a means of reconciling the conflicting views of those who have been contending for effective federal control and those who maintain the right of the states to regulate their internal affairs it was generally accepted at first that the Cole bill would pass without opposition. On closer reading, however, those who are opposed to the extension of federal authority over the industry saw in the provision for a Petroleum Administrative Board and the functions assigned to that body the entering wedge of a movement toward the assumption of control by the national government. Representatives of the American Petroleum Institute hastened to Washington to oppose this feature of the bill and leaders of the states' rights bloc voiced their objections while protests were received from individual members of the oil industry.

As a result of this flare-up Senator Connally of Texas on August 13 introduced a new bill which made permanent the temporary Connally hot oil act, authorized the interstate compact and provided for limitation of imports. This bill was immediately passed by the Senate and although held up for one day by objection of Senator George of Georgia who wanted to look into the import limitation provision was finally adopted on August 15.

There was more behind the fight over the provision of the Cole bill creating the Petroleum Administrative Board than appeared on the surface. It was charged by the critics of the bill that the setting up of this board was a strategic move on the part of the advocates of federal control to lay the groundwork for more restrictive legislation at the next session. The theory behind this claim is that the federal regulationists feel that neither interstate action nor the private efforts of the oil industry will establish the needed stabilization of production before the next meeting of Congress and that since it will be possible to point to a failure of these methods the way will be opened for more stringent legislation applying to oil the same treatment that the Guffey bill provides for the coal industry. That is conceded to be the ambition of certain members of the Administration.

Another complication that has been a sub-surface factor in the situation has been the antagonism in certain quarters to placing any authority over the oil industry in the hands of former Oil Administrator Ickes. This led to the proposal for a separate board but without any certainty that the board itself might not be placed under the Secretary of the Interior. That part of the industry represented by the American Petroleum Institute has urged consistently that if the federal government's participation in oil affairs is to be limited to factual studies and reports that function may very well be exercised as in the past by the Bureau of Mines. Meanwhile the Petroleum Administrative Board as it was constituted under the NRA regime is going ahead with a survey of the industry which may or may not furnish ammunition for a further campaign for federal control.

At this writing, with the adjournment of Congress only a few days away, it appears doubtful whether any oil legislation will be adopted. If so it apparently will be the Connally bill. Whether or not it goes through the result must be regarded as a victory for the opponents of federal control.

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Trinidad

THE YEAR 1934 proved to be a record one for the Trinidad oil industry, as disclosed by official report of the government, the main features being that the deepest well in the island was completed at 6,400 ft., the largest output of crude oil —10,894,363 bbl.—was obtained since the inception of the industry, and exports of petroleum and products nearly reached 10,000,000 bbl. The year was also marked by the highest monthly production of over 1,000,000 bbl. of crude oil.

During the year 124 new wells were commenced making a total of 2,106 wells drilled in the Colony to the end of 1934, there being 1,339 on Crown and 767 on private lands.

Of the 118 wells completed in 1934, 114 wells were completed as producers.

The approximate value of the crude produced was $7,525,120 as compared with $5,962,348.80 the value of 9,561,354 barrels produced in 1933.

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A. A. P. G. Convention

ARRANGEMENTS are being completed by the American Association of Petroleum Geologists for a convention in Mexico City, October 16–17. It is expected that some 200 delegates will attend. Official welcome and entertainment by the federal government and the National Geological Institute of Mexico are being prepared. It is understood that the delegates will visit the principal Mexican oil fields before returning to the United States.

Foreign Oil Legion

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Captain Thorkild Rieber

THE NAME Thorkild carries with it a suggestion of Nordic vigor. In this respect it admirably fits Captain Thorkild Rieber who has just been elected Chairman of the Board of The Texas Corporation, succeeding the late Judge C. B. Ames. Captain Rieber is a man of dynamic personality, trained to great endurance by his seafaring apprenticeship, of sound judgment and forthright expression. His appointment will be hailed with satisfaction by his wide circle of friends and acquaintances in the oil industry.

PETER ALEXANDER MCKILLOP, who for the last 35 years has represented Vacuum Oil Company interests in Scotland has retired. A complimentary dinner was given in his honour attended by colleagues and business friends, men well-known in Scottish industry. Mr. McKillop is an active member of the Institute of Engineers and Shipbuilders, the Institute of Electrical Engineers, the Institute of Mining and Electrical Engineers, and is a past president of the Engineers "Forty" Club.

M. A. SCHENK for several years has been in charge of purchasing for the Royal Dutch-Shell group at The Hague. For sometime Mr. Schenk was in charge of purchasing in the Asiatic Petroleum Corporation in New York where he made many friends. Mr. Schenk is also chairman of N. V. Thomassen and Co., of De Steeg, Holland, builders of oilfield equipment and Diesel engines.

DR. W. V. HANKS, head of Standard Oil Development Company's information department and assistant to R. T. Haslam, failed to rally from an appendicitis operation in June and died in France. Mr. Hanks was about to return to the United States on the maiden voyage of the NORMANDIE when he was stricken with appendicitis. Mr. Hanks graduated from the University of Wisconsin in 1923 and took graduate work in chemical engineering at the Massachusetts Institute of Technology, joining the newly formed research laboratory of the Standard Oil of Louisiana in 1927. He worked on the perfection of the hydrogenation process and it was under his supervision that commercial production of Paraflow was first accomplished. In 1932 he was transferred to New York. In the accompanying illustration, taken by a member of the WORLD PETROLEUM staff at The Hague, Mr. Hanks is seated with Mr. Prioleau, general manager of Petroleau, and Mr. Horstmann of N. V. American Petroleum Co., The Hague.

W. V. Hanks, H. F. Prioleau and A. C. H. Horstmann

M. A. Schenk

SR. RODOLFO P. PERACCA of Buenos Aires, who is agent for Lobitos Oilfield Ltd. and Ecuadorian Oilfields, Ltd. in Argentina, Uruguay, and Brazil, is making a trip through the United States. Sr. Peracca is an active and prominent figure in the international petroleum industry and has been closely identified with the development of the Ancap refinery in Montevideo. The purpose of his present trip, however, is to extend to various prominent Americans personal invitations to attend the Fourth Centenary celebration of the founding of Buenos Aires which is to be held in February 1936.

Sr. Rodolfo P. Peracca

The Key to Tomorrow's Profits—

Lies in Today's Technical Research. Study of Production Technique and Recovery Methods Adds to Available Reserves of Oil as Surely as the Discovery of New Fields. By Lester C. Uren

Professor of Petroleum Engineering
University of California

WITHIN recent years, notable advances have been made in petroleum production technology, leading to greater recovery efficiency and lower unit production costs. This improvement has been due, primarily, to engineering development and research initiated by the more progressive oil producers and equipment manufacturers and by various professional and industrial organizations, educational institutions and government agencies. Today we find certain parts of this programme well advanced; other phases have as yet been scarcely begun. Many of the problems of oil production yet remain to be explored and solution of these problems will make the oil industry of the future a far more efficient one than that of today. The present article by an authority on petroleum engineering reviews recent achievements in the field of petroleum production research and attempts to forecast the future trend of the effort to improve production efficiency in the oil industry.

CAPITAL expended in petroleum production research and in development of improved recovery methods, should be directly productive of increased recovery efficiency that promises to repay many fold, the cost of conducting the investigative work. A mineral-producing industry that is less than 25 percent efficient, particularly one of such magnitude and economic importance as the petroleum industry, offers a tempting avenue of industrial research. That the actual recovery of petroleum by present-day commonly-used methods, is successful in recovering less than 25 percent of the oil originally present in our oil fields, may be proven by several different methods of approach. The remaining three-quarters of the original oil content of the producing formations holds forth the definite promise of oil recoveries of from two to four times those secured by present methods, if and when the improved methods are developed.

The larger oil-producing companies annually expend many millions of dollars in the search for new oil deposits, only to take less than one-fourth of the oil so found because of inefficient methods of oil recovery. The United States petroleum industry has thus far produced about 18,000,000,000 bbl. of oil. If the above 25 percent estimate of percentage recovery is correct, there must be left behind in present-known fields in this country, a reserve of upwards of 50,000,000,000 bbl. of oil, non-producible by present ordinary methods of recovery, but producible in part by improved methods.

It is said that one "wild-cat" well in two hundred is productive of oil in commercial amounts. While this figure may, perhaps, be reduced by continued development and application of geologic and geophysical knowledge, it cannot be denied that money spent in the search for new oil deposits is at best, a highly speculative investment. The cost of only a few "dry holes," expended each year in production research, would support a first class research and development organization that could scarcely fail within a few years' time, to be productive of information leading to improvements in production technique worth many times the sums expended in its support. To be sure, many "dry holes" are also sunk in research laboratories, but there are so many lines of research of such definite promise awaiting investigation, success in any one of which would amply justify the total cost, that the financial risk involved in such an investment would appear to be slight.

Even though only minor increases in production efficiency are secured from such work, due to the large volume of production to which it may be applied, important increases in revenue and profit will result. Consider for example, the case of an oil company which controls a production of, say, 80,000,000 bbl. per year, which is produced, let us assume, at an average cost of 75 cents per barrel and is sold at an average price of $1.00 per barrel. If by a close study of production technique, the cost of production could be reduced by only 5 cents per barrel, the total increase in profits would amount to $4,000,000 per year. Even though the ultimate production of petroleum could be increased by only 10 percent, assuming that the increased volume of oil could be produced at the same cost, an additional annual profit of $2,000,000 would result. Improved production methods also promise a more rapid recovery of the available oil, with consequent decrease in interest charges on the capital investment and increase in present value of prospective income. Considering the large sums involved and the high rate of interest that attaches to investments in oil-producing properties, a reduction of even 10 percent in the total productive life of an oil-producing property, represents a saving of many millions of dollars. It is believed that the percentage of increased recovery, decreased time of realization and decreased production cost suggested, convey a conservative picture of what might actually be accomplished by a thorough-going technical study of oil production methods.

BEFORE we may devise new methods or systems of oil recovery, we must understand better than we do today, the conditions attending the occurrence of petroleum in nature and the manner in which it flows through the reservoir rock into the wells. More must be known concerning operation of the forces that expel the oil from the reservoir rock and the retentive forces that are responsible for the low percentage recovery secured by present-day production methods. Better understanding of the natural forces operative and of

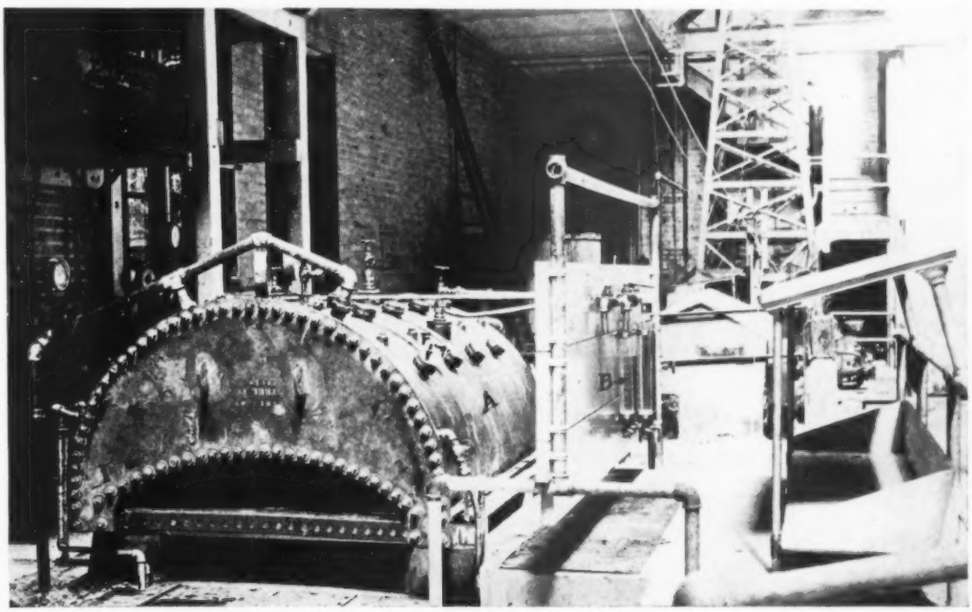
their interrelationship, will perhaps suggest ways in which the expulsive forces may be more efficiently utilized and the influence of the retentive forces minimized.

Studies of the properties of petroleum as it exists within the reservoir rock and as influenced by changes in temperature and reservoir pressure, have afforded a fascinating field of research. It is only a matter of nine years since Dow and Calkin and Beecher and Parkhurst published the results of the first scientific studies that were made on the solubility of natural gas in petroleum and of the influence of dissolved gas on the properties of the oil. Disclosure of the fact that petroleum is capable of holding such large quantities of gas in solution at elevated pressure, and the important changes in viscosity and surface tension of the oil that result from solution of gas, went far toward dispelling the fog that had hitherto surrounded the subject of sub-surface behavior of petroleum. This research provided the foundation upon which could be based a reasonable explanation of the mechanism of expulsion of petroleum from its reservoir rock. More recently, Mills and Heithecker have contributed additional data on the influence of dissolved gas on oil density and volume, from researches conducted under U. S. Bureau of Mines auspices. Lindsly, also of the U. S. Bureau of Mines, has made interesting observations on the loss of volume suffered by oil as a result of release of dissolved gas and vaporization of light fractions on reduction of pressure from reservoir to atmospheric conditions.

The results of these and other investigations assist us in reaching an understanding of the occurrence of petroleum in deep-seated oil deposits and of their behavior on release of pressure and reduction of temperature. Important contributions to our knowledge of geothermal gradients and the reservoir temperatures in various American oil fields, have been made by C. E. van Orstrand, A. J. Carlson, E. M. Hawtoff and others, working under American Petroleum Institute and U. S. Geological Survey auspices.

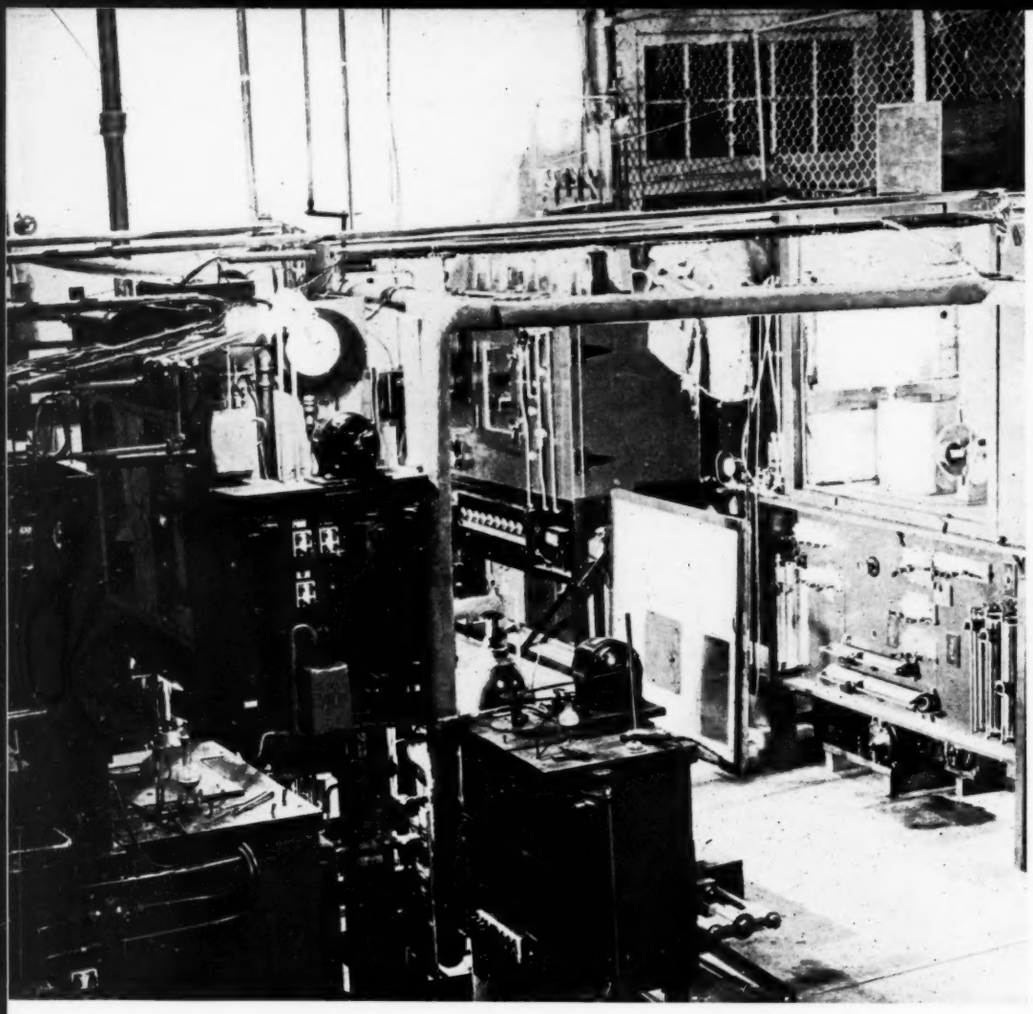
Many research workers have been interested in studies of the natural forces that are responsible for the expulsion of petroleum from the reservoir rock into wells, and the manner in which they operate. Broadly, we may explain these forces as expressions of (1) the expansive force of natural gas associated with the oil; (2) the action of gravity on the rock fluids; and (3) the hydraulic effect of water under pressure, tending to drive out and replace the oil in the reservoir rock. S. C. Herold has classified reservoirs under the influence of these different forces from the standpoint of fluid mechanics and has analyzed the behavior of wells producing under each of the different "controls." Most petroleum technologists have regarded gas energy as the most potent force in determining the expulsion of oil from the reservoir rock and many research projects have centered around this aspect of petroleum production technology. I. I. Gardescu, working in the Petroleum Engineering Laboratories of the University of California and the Gulf Oil Company laboratories in Pittsburgh, has made intimate studies of the behavior of gas bubbles in their movement through the capillary interstices of oil-saturated sands, and of the so-called "Jamin action" or distortion resistance of gas bubbles, that some authorities believe to have an important influence in limiting the recovery of petroleum. He has also shown that oil in the reservoir rock has a tendency to remain super-saturated with dissolved gas.

Many research workers have investigated and attempted to formulate the different factors that determine the resistance to flow of oil and oil-gas mixtures through sands and sand-stones. This is measured by the "permeability" of the reservoir rock, which is a function of the size and shape of the pore spaces, character of the mineral grain surfaces, the viscosity and surface tension of the oil and the differential pressure imposed. W. O. Smith, R. D. Wyckoff, H. G. Botset and M. Muskat of the Gulf Oil Company's research organization, have made notable contributions in this phase of petroleum technology, as has P. D. Nutting of the U. S. Geological Survey. Flow resistance has been found to vary directly as the rate of flow, in accordance with D'Arcy's Law. Because of this relationship, the Research Committee of the American Petroleum Institute has recently adopted the name "darcy" as the name of the unit of permeability. Several laboratories are now engaged in programmes of research involving permeability measurements of core samples of oil reservoir rocks from various American fields. Such data, expressed in the darcy unit for convenience in comparison, will afford a new approach to certain drainage problems. Outstanding contributions involving studies of rock permeabilities and the factors involved in determining permeability, have been made by C. F. Barb, G. H. Fancher, J. A. Lewis and K. B. Barnes of the School of Mineral Industries of Pennsylvania State College, and by F. G. Tickell and associates of Stanford University.



Miniature oilfield used in drainage studies, University of California, consisting of a sand-filled tank (A), receiving cylinders (B), absorber (D), miniature wells (E), sampling nipples (F), and removable end of tank (H).

The writer and his associates, working in the Petroleum Engineering Laboratories of the University of California, have made observations of the characteristics of flow of gas-saturated petroleum under high reservoir pressures. A novel type of apparatus has been used which, it is believed, duplicates every condition that exists within the reservoir rock in the vicinity of a high-pressure flowing well. With this apparatus it has been found



General view of petroleum research equipment at the California Institute of Technology at Pasadena.

possible to study the form of the pressure gradient within the reservoir rock about a well and to observe the influence of rate of flow, back-pressure and well diameter upon the pressure gradient. Out of these investigations have come new data suggesting ways of realizing greater efficiency in the utilization of natural gas energy. By extrapolation of pressure gradients, it is possible to predict the field pressure, gas-oil ratio and rate of flow of the fluids at any distance from the wall of a producing well under given reservoir conditions. Such information is useful in estimating the proper spacing of wells. Perhaps the most significant information that has come out of this research is the greater efficiency of large diameter wells.

A prolific field of research has been found in the study of bottom-hole pressures in producing wells. Instruments have been devised, which may be lowered to any depth in a well and which will yield a continuous record of pressure variation at that point. Bottom-hole pressures are particularly interesting in that they are the nearest approach to reservoir pressures that can be obtained. They provide an accurate record of the back-pressure imposed on the productive formation by different types of well and surface equipment and different systems of well operation and control. They afford a means of maintaining records of decline in formation pressure in the vicinity of wells, that has become the basis for a logical system of proration and equalization of formation pressures throughout a productive area. Pioneer work in developing and applying bottom-hole pressure-recording instruments, must be credited to engineers and research workers in the employ of the Amerada and Humble oil companies and petroleum technologists of the U. S. Bureau of Mines. More recently, many other oil company technical staffs have taken up reservoir pressure studies as regular routine in their subsurface investigations in the newer fields now under development.

Whether or not the oil is fully saturated with dissolved gas as it exists within the reservoir rock, is a matter of considerable interest in determining upon a policy of pressure control in well operation. Instruments have lately been devised for taking bottom-hole samples of oil under high pressure, withdrawing them to the surface in pressure bombs for laboratory determination of saturation pressures. Such work has been done, with considerable advantage to operators in the East Texas field, by U. S. Bureau of Mines petroleum technologists; and by engineers of the Anglo-Persian and Burmah Oil Companies in certain of their Asiatic oil fields.

There has been much difference of opinion among production men as well as petroleum engineers, concerning the percentage recovery secured in exploitation of oil deposits. Laboratory research conducted under the supervision of the writer has indicated possible recoveries obtainable from unconsolidated sands under the most favorable conditions to be as high as 80 percent. Such a recovery is possible in laboratory apparatus only by prolonged gravity drainage or by carefully controlled edge-water flooding, and it is highly improbable that field recoveries are ever so efficient. By gas expulsion alone, displacement efficiencies as high as 40 percent have been obtained under laboratory conditions, the percentage recovery increasing directly with the initial saturation pressure. Studies of field recoveries in most cases indicate materially lower yields, 15 or 20 percent being perhaps a fair average for present-day, commonly used methods of flowing and pumping.

The reasons for the low percentage recovery are apparent from the results of researches, also conducted by the writer and his associates, designed to disclose the influence and magnitude of the retentive forces. A large percentage of the original oil content is often retained in the reservoir rock as a result of the force of capillarity, which tends to hold the oil in the smaller rock openings. The mineral grain surfaces are also necessarily left wet with adherent oil, and even though this residual film of oil may be very thin, yet the large grain surface exposed to the oil (often several thousand square feet per cubic foot of reservoir sand) nevertheless may account for a large percentage of the original oil content. Intimate studies of the mechanics of gas-bubble action in expelling oil from oil-saturated sands, have also indicated that much of the original oil content is left behind in the reservoir rock on release of gas pressure, by "slippage" or "by-passing" of gas through the oil and through the partially oil-drained spaces of the reservoir rock.

Displacement of residual oil by edge-water encroachment or by intentional water-flooding, is often inefficient because of irregular advance of the water through the more permeable drainage channels, leaving much of the less permeable reservoir rock oil saturated. Some interesting research has been done in observing the replacement of oil by water in oil-wet sand compacted into glass apparatus.

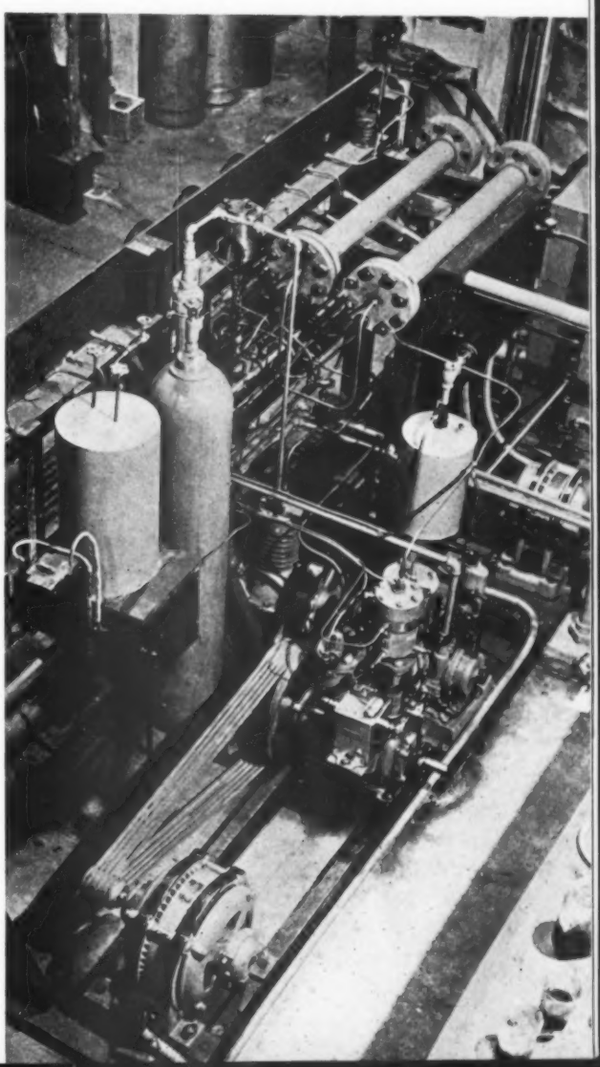
Hearst Memorial Mining Building, housing the petroleum engineering laboratories at the University of California, Berkeley, California.

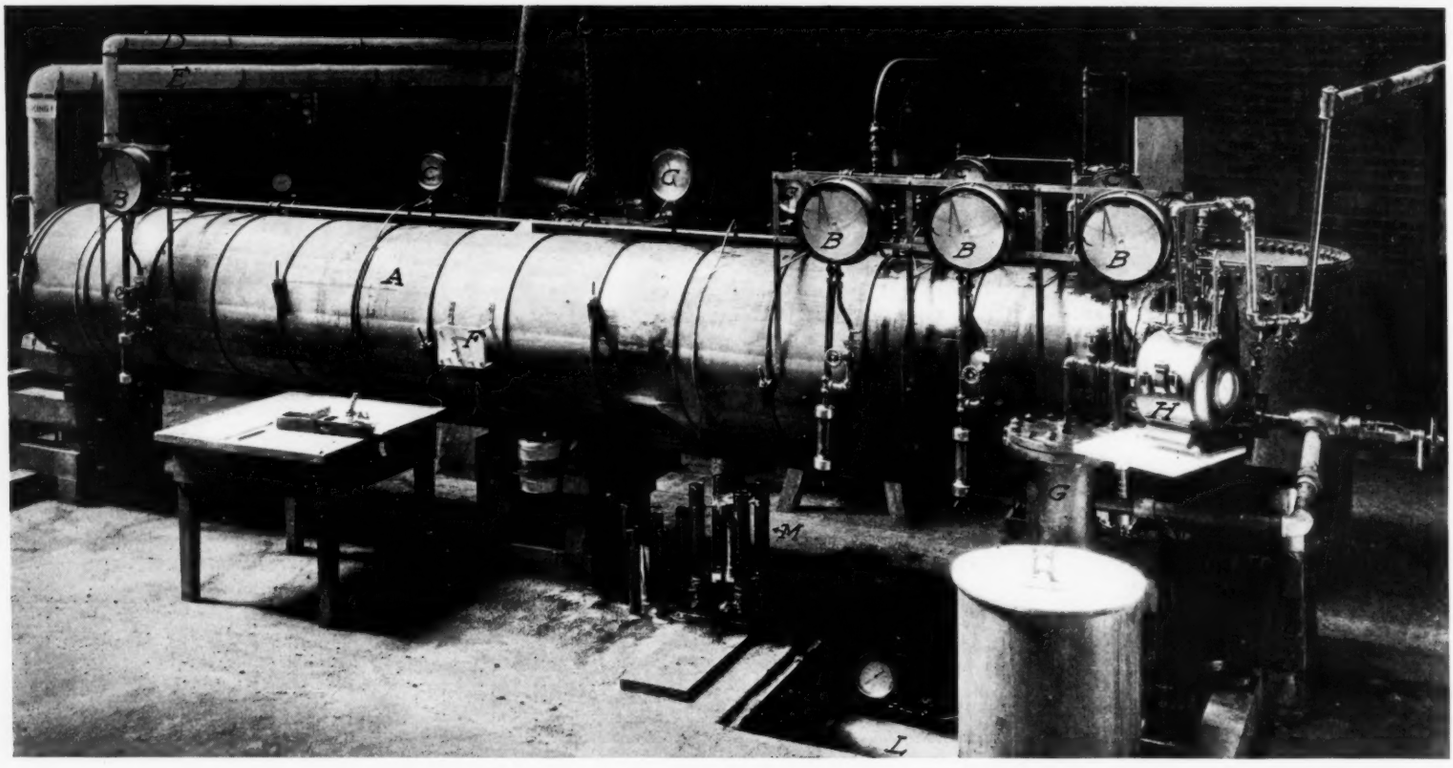
THE RATHER low recoveries secured by ordinary "primary" methods of field exploitation, have led many producers to study the so-called "secondary" methods in which artificial forces are brought to bear to stimulate recovery. The use of vacuum, pressure restoration methods, gas driving, water flooding and drainage through mine openings have each been extensively studied by research methods, both in the laboratory and in the field. Lindsly and Berwald of the U. S. Bureau of Mines, have made studies of the increased recovery secured through the use of vacuum; Chalmers, Desmond and others of the Bureau staff have conducted an elaborate research programme on the gas-driving method of recovery. Wilde, Parks and others of the research staff of the Humble Oil and Refining Co. have conducted successful and carefully controlled tests of the gas-pressure maintenance and gas-pressure restoration methods of recovery in the oil fields of Texas. Gulf Oil Company technologists have been active in a programme of research, designed to explore the advantages of secondary recovery methods, particularly the water flooding method that has been so successfully applied in the Bradford field of Northern Pennsylvania. The possibility of applying the "oil mining" method, as practiced in the Pechelbronn Mines in Alsace, and as contemplated by the Ranney Oil Mining patents, to Appalachian and Mid-continent oil fields, has been thoroughly studied by engineers in the employ of the Standard Oil Development Co. Physical conditions are not unfavorable, but economic conditions and a surplus of flush oil have of late, offered little incentive for the application of this more efficient method of oil recovery.

THE DIFFICULTIES encountered in lifting oil from deep wells have engaged the interest of many research workers during recent years. Whether a well is free-flowing or whether the oil must be elevated by gas-lift or by some type of mechanical pump, there are many problems that require engineering study, most of which are susceptible to solution by research methods. Notable progress has been made during the last ten years in reaching a better understanding of the factors that influence the efficiency of the several methods and devices used in the lifting of oil.

In earlier times, oil producers have been content, where the reservoir rock contained sufficient gas energy, to allow wells to flow their production to the surface with little or no effort to control or regulate the process. Today, we realize that uncontrolled flowing of wells may be wasteful of reservoir energy and that suitable regulation of the rate of flow and back-pressure employed have an important influence on ultimate recovery. Research engineers, with the aid of bottom-hole pressure-recording devices and by analysis of gas-oil ratios, have made careful studies of variation in the rate of consumption of reservoir energy with changes in the rate of production. Rates of production may be predicted for any given differential pressure between the well and the formation. Design of the well equipment to yield maximum efficiency in operation of flowing wells has received much attention. Determination of the best size and length of well tubing to be used for a given set of

Natural gas liquefaction equipment used in purification of methane and ethane in the petroleum laboratories of the California Institute of Technology.





The conical tube and incidental apparatus used in drainage studies.

conditions, possible use of "tapered" flow strings, types of chokes to be employed in restricting flow and location of the choke for best results, are all matters that have required careful and prolonged research by competent engineering personnel.

Though in reality a special type of flowing well, the gas-lift presents a more complex problem in design and physical control, because there are a greater number of variables involved and more of them are within the control of the operator. Several efforts have been made to formulate the variable factors on the basis of results secured in detailed studies of performance of gas-lift wells and on the results obtained with small scale experimental gas lifts. Petroleum technologists of the U. S. Bureau of Mines have given a great deal of time to this particular problem, and notable contributions have also been made by research workers of several oil companies.

Five different types of gas-lift flow are recognized and each is probably governed by a different mathematical relationship of the physical variables involved. In as much as more than one of these different types of flow are simultaneously operative, a most complex problem is presented.

Oil well plunger pumps have been extensively used in lifting oil from wells for many years and one would expect that oil producers would long since have learned all there is to know about this simple and mechanically primitive device. Such a conclusion, however, would be far from the truth. During recent years, many engineering research workers have been giving attention to the problems involved in increasing the efficiency of operation of plunger pumps in lifting oil from deep wells. Development of special types of dynamometers for recording variations in stress in sucker rods used in pumping wells, have greatly assisted in this work. Detailed studies of the effects of length and timing of stroke, size of plunger, stretch of rods, valve operation and design, submergence, gas and sand control and other factors, have resulted in material improvement in volumetric efficiency and have made possible efficient operation of plunger pumps at depths hitherto impossible. Slow-motion pumping, an outgrowth of these studies, has resulted in important economies from the power consumption standpoint, and improved pump efficiency. Some outstanding examples of profitable industrial research are also to be found in the development of high tensile strength steel for use in the manufacture of sucker rods for deep well pumps.

Difficulties experienced in operating rod-actuated pumps in deep wells have led many engineers to interest themselves in other types of pumping devices that are gradually finding application in well pumping service. Among these, the electrically-driven multi-rotor centrifugal pump and the hydraulically actuated type of plunger pump are of particular interest. Successful application of these new types of pumps has in each case been achieved only after a prolonged period of development by competent engineers and research workers.

OIL PRODUCERS in the past have given too little attention to the matter of maintaining their wells in the best possible condition for efficient operation. When one considers the problem of draining large quantities of gas and oil through the comparatively small area presented by the pore spaces of the reservoir rock exposed in the wall of the well and opportunities that exist for clogging these pore spaces with detrital material, waxy deposits and precipitated inorganic salts, it is apparent that much may be gained in promoting production efficiency by keeping these channels of communication with the reservoir rock as unrestricted as possible. Recently, acid treatment of wells producing from calcareous reservoir rocks has found extensive application. Research workers of the U. S. Bureau of Mines have investigated and disclosed methods of combating paraffin and inorganic precipitate accumulations in wells. Types of screens successful in restraining sand incursion into wells have been perfected and new methods of washing and hydraulicking detrital accumulations lodged about the screens and bottoms of wells, are finding use. The writer and his associates have recently completed a research project indicating that gravel envelope screens, such as are used in water wells, have very definite advantages in sand control in oil wells. The advantages of hydraulically formed, gravel-filled cavities about wells within the reservoir rock, as a means of increasing drainage efficiency, have been

established largely by laboratory research methods but have also been proven in the field in recent water well installations.

AFTER the oil and gas are discharged from the wells at the surface, their subsequent treatment to eliminate impurities and care in handling and storage present many problems that have provided the incentive for research. Prominent among these is the problem of dehydration and the development of methods of lifting and handling oil that result in a minimum tendency toward formation of refractory oil-water emulsions. Dehydration of emulsified oil, produced in great quantities in many of the Mid-continent, Gulf Coast and Western fields, has been difficult and costly. The widely used chemical and electrical methods of demulsification have been a result of many years of research and development that is still being continued by research workers. Much useful research in this field and assembling of pertinent data have been done by technologists of the U. S. Bureau of Mines.

Evaporation losses of oil in storage and during passage through the producer's dehydrators, lease, storage and shipping tanks, have also been the subject of prolonged studies by U. S. Bureau of Mines engineers. The important economic loss thus disclosed, has led to the development and general adoption of improved vapor-tight oil-storage containers. Much oil in field storage has been lost by fire, often resulting from static discharges during electrical storms. Engineering studies of the lightning hazard, both in the laboratory and in the field, have led to the adoption of special types of tower and wire-network protection about tank farms and large oil-storage reservoirs, now widely used in the California oil industry.

THE MORE active agencies engaging in the field of petroleum production research in the United States, have been indicated in the foregoing sections summarizing the character of work upon which they have been engaged. Among the government agencies, research organizations and educational institutions active in this field, the following are worthy of particular mention: U. S. Bureau of Mines, U. S. Geological Survey, Mellon Institute of Pittsburgh, Pennsylvania State College, University of Oklahoma, Colorado School of Mines, University of California (Berkeley), Stanford University, and California Institute of Technology. American oil company research staffs particularly active in production research, include those of the Gulf Oil Company and subsidiaries, the Humble Oil and Refining Co., the Shell Oil Company, the Standard Oil Development Co., the Standard Oil Co. of California, the Standard Oil Co. of Indiana and subsidiaries, the General Petroleum Corporation, the Union Oil Company of California and the Continental Oil Co.

Abroad, the Anglo-Persian Oil Co., Burmah Oil Co., and Shell Oil Co. technical staffs seem to have been doing particularly outstanding work in the field of production research. The University of Birmingham, England, known more particularly for its splendid work in the field of refinery research, is also giving some attention to production research problems. The monthly "Journal" of the Institution of Petroleum Technologists is outstanding among European publications serving this field and the Proceedings of the 1933 World Petroleum Congress, recently published under I.P.T. auspices, contain many excellent papers presenting the results of petroleum production research. Russian research institutes at Moscow, Grosni and Baku are very active in promoting many production research projects and are printing the results of much of their investigative work in the monthly magazine AZERBAIDJAN OIL INDUSTRY, published at Baku.

CONSIDERING the prospects for future research in the field of petroleum production, it seems probable that work to be done during the next few years at least, will follow the trend established during recent years. The possibility of discovery in the near future, of radically new and much more efficient methods of recovery than those now known would appear to be slight. There is opportunity however, for great progress in the perfection of present methods or methods already visualized as the result of past research. Much of the pioneer work thus far undertaken has been hurriedly done in the hope of making some outstanding new discovery. Many promising by-paths have been left unexplored and the progress made during the last ten years must now be consolidated and the many gaps in our information filled in by pains-taking research.

It would seem reasonable to expect that there is special opportunity for worthwhile new developments in further study of the so-called "secondary" methods of recovery. It appears probable that the industry must in future depend to an increasing extent upon the pressure maintenance, pressure restoration, gas-driving, water-flooding and mining methods of recovery, and we have much yet to learn about them before they may be applied with maximum efficiency. There is need for much additional work on drainage fundamentals, with the purpose of promoting better understanding of the physical conditions under which oil occurs at great depths within the earth and its behavior under the influence of the expulsive forces operative. Better understanding of the retentive forces and of their mode of operation may lead to the development of new methods of minimizing their influence. The writer believes that there is room for great improvement in production

Part of the group of buildings that house the petroleum production research laboratories at Baku, U.S.S.R.

efficiency in both primary and secondary production, by the drilling of larger diameter wells through the reservoir rock or by forming cavities about the wells within the reservoir rock, and additional investigative work remains to be done in promoting this technique, particularly in the field. As time passes, we must produce oil from wells of ever greater depth. There is real need for improvement of the pneumatic methods of lifting oil and for perfection of new types of pumps capable of operating efficiently at great depths. For those who may wish to read in greater detail of what has been done along production research lines during recent years, a selected bibliography is appended.

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Liquid Fuels

LIQUID FUELS, Harold Moore, Technical Press Ltd., London 1935. (21/–)

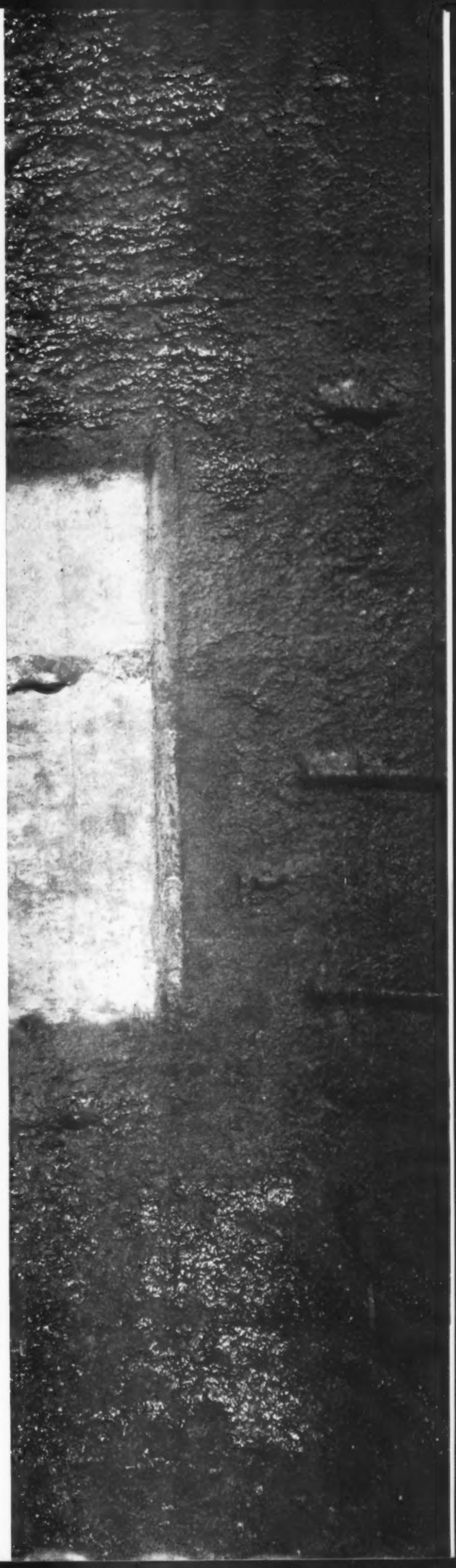
Unlike so many of its predecessors, this book definitely does fulfil the claim made for it; that it is a practical treatise on liquid fuels for engineers and chemists who are not specialists in this subject. It is, moreover, a considerable improvement on the author's previous publications of 1917 and 1920, and in view of the recent advances made in this subject during the last 15 years, constitutes an entirely new work on liquid fuels.

The book is divided into six parts dealing with (1) chemistry of liquid fuels, (2) their preparation, (3) relation between the chemical and physical properties of fuels and engine efficiency, (4) fuels for internal combustion engines, (5) fuels for external combustion, (6) significance of tests and analytical methods for the evaluation of liquid fuels. An appendix is given containing tables for viscosity conversion, graphs and charts.

The chapter on the utilization of fuels for external combustion is of particular value and the subject matter is exceptionally well arranged and illustrated.

In conclusion, the book is to be recommended to all those interested in liquid fuels, and should also find a place in the petroleum technologist's library.

Spraying 0.015 in. aluminum coating in a Dubbs reaction chamber.



The first metallizing job for an oil refinery was done several years ago in the Mid-Continent fields.

Spraying Liquid Metal to Decrease Corrosion

By R. E. Kunkler

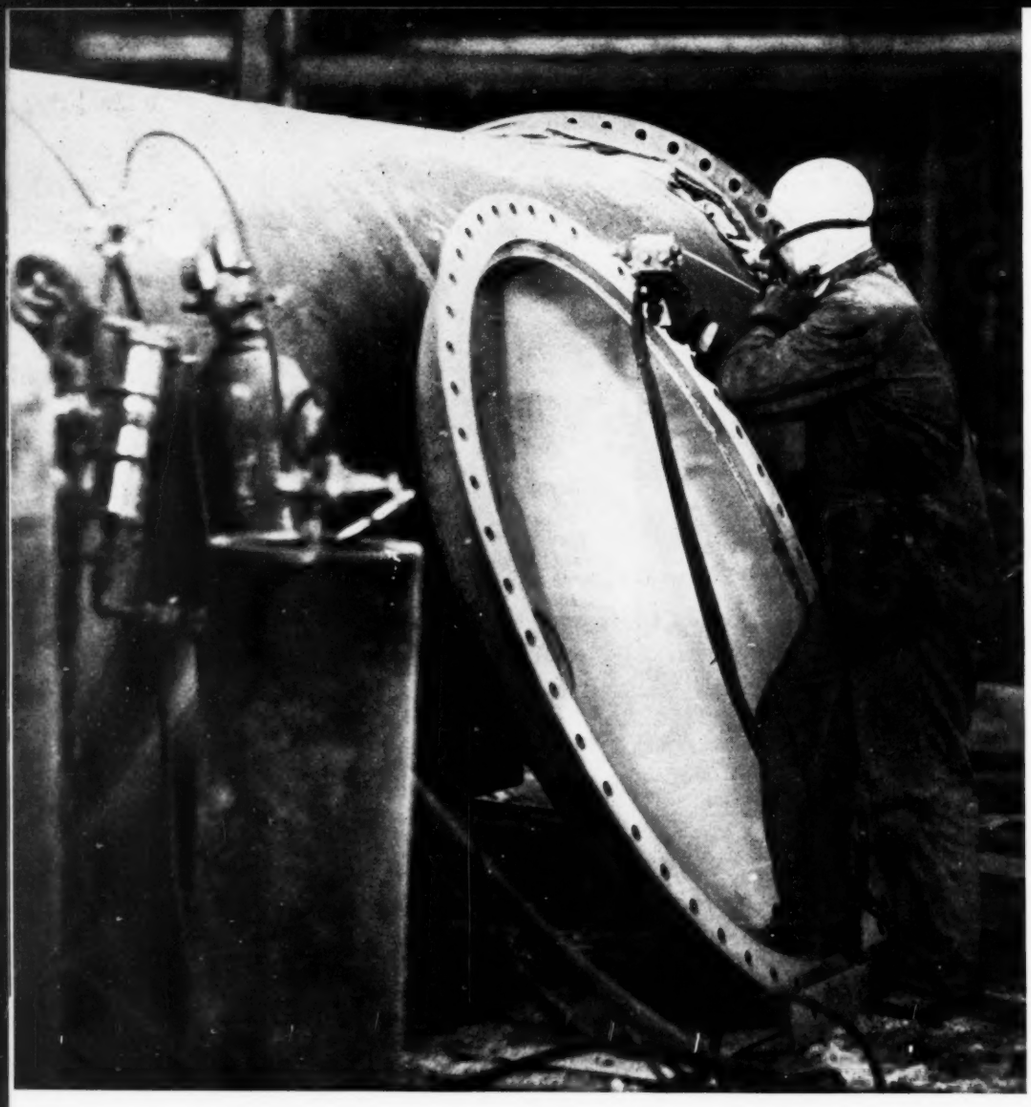
ONE OF THE greatest problems confronting the oil industry today is hydrogen-sulphide corrosion in cracking units. In the United States alone, such corrosion costs refineries many millions of dollars yearly. While many methods have been tried to combat this costly corrosion problem, the newest and most successful method is that of metallizing. This method consists of spraying pure aluminum on all surfaces subject to this corrosion by means of an ingenious piece of equipment which might be described as a combination welding torch and paint spray gun. This gun, using an oxy-acetylene flame and compressed air melts any metal drawn into wire form and drives the molten particles on to any surface at a velocity of five miles a minute, giving a surface coating of pure metal.

This method has met with such success that it is rapidly being adopted as the most efficient and economical means of preventing such corrosion. Not only are a great many of the aggressive refineries standardizing upon this method of corrosion prevention in their new installations of equipment, but old equipment is also being protected.

A survey has been made of the saving achieved in a small refinery located in the northwestern part of the United States. This refinery uses Sunburst crude oil, which has a very high hydrogen-sulphide content, and is known to be extremely corrosive. Unprotected equipment was installed. Inspection after nine months revealed a loss in wall thickness of 3/16 of an inch in the dome of the reaction chamber and excessive corrosion in the flash chamber. Conservative estimates indicated that these chambers which represented an investment of approximately $32,000, would last but eight years. Further, with decreasing wall thickness, working pressures would have to be reduced after six years with proportionate decreases in operating efficiency. Under these circumstances, the corrosion bill for these two towers totalled more than $4,000 a year.

These two towers were lined with .015 to .020 aluminum by metallizing at a cost of approximately $500. Six months later, the chambers were again opened and examined, and it was found that the aluminum coating had stopped corrosion. At the end of one year, the protective aluminum coating was still in perfect condition. Recently, this company has applied an aluminum coating to their column with equal success.

Another plant located in Canada bought metallizing equipment at the same time as



Lead coating an acid tank.

the above refinery. Using the same grade of crude, their reaction and flash chambers were approaching the danger point. In order to prolong the life of these chambers, this refinery had ¼-in. steel sheets welded on to the inside walls of both vessels at a cost of approximately $15,000. To do this, production was stopped for three weeks. Such a procedure merely delayed corrosion for a short period of time, and it was soon discovered to have progressed farther behind the steel sheets. They were constantly in fear that these sheets would break loose and plug up the towers.

This company purchased metallizing equipment and replaced the steel sheets by an aluminum coating. The results proved satisfactory and several months later they lined two 10 by 40 ft. towers at another of their refineries.

The first metallizing job for an oil refinery was done several years ago in the Mid-Continent oil fields. A 10 by 40 ft. Dubbs coke chamber was selected for the experiment. Thirty-five square feet were coated in two sections, one of which was located on the dome where severest corrosion from hydrogen-sulphide takes place. This latter section was not only subject to corrosion but to the added condition that picks were used in order to dislodge coke from the side walls. At the time of metallizing, it was thought that this cleaning operation might damage the coating. After a five months test run, inspection was made and the aluminum was found to be in perfect condition. A discussion arose as to what would happen if a pick were driven completely through the aluminum into the steel. This was done in twenty places and the tower was put again into service. Six months later, on examination, it was found that at none of these spots had the corrosion got behind the aluminum. The aluminum was intact around all the pick holes and around all the edges of the two sections. These spots were repaired and one year later, it was definitely proven that aluminum would not react to hydrogen-sulphide. It was also proven that a non-porous coating could be deposited and would prevent corrosion in high pressure vessels.

As a result of this test, a great many refineries and experimental companies made test jobs. One large company in the Chicago area had a bubble tower which averaged about 0.06 in. to 0.14 in. corrosion per year unless it was protected in some manner. As a test job, this unit was sprayed with 0.008 in. of aluminum. At the end of 3,000 hours of service, the coating was found to be in perfect condition; no corrosion had taken place. This job was very unusual in that 0.015 in. aluminum is ordinarily applied.

The largest research company in connection with the oil industry heard about this successful test and metallized a 5 by 25 ft. test unit that was used exclusively for experimental purposes. The results obtained, indicated that metallizing was a satisfactory solution to their sulphide corrosion problems.

One company, after using metallizing for a number of years in their cracking units, recently let a contract for five new 5 by 40 ft. reaction chambers to be lined with aluminum. Another company had 14 vessels, totalling some 32,000 sq. ft. aluminum coated immediately after fabrication. It is significant to note that another company has recently aluminum-sprayed two coke fractionating columns which were fabricated for use outside the United States.

A great many refineries have purchased their own metallizing equipment. Even small plants running 500 to 1,000 bbl. of crude a day have found such equipment highly useful around their plants. Metallizing has been found useful for maintenance of pumps and other various equipment around the plant.

The principal use, aside from coating high pressure chambers, is the building up of hot oil pump rods with either 120 carbon steel or stainless steel. This sprayed coating gives a much harder wearing surface than the original shaft. A great many pump rods, bearings, and shafts are being built up to original dimensions. One large refinery recently made a test by building up several fluid end piston rods with high carbon steel. Two pumps were selected to try them in. In each pump, one new rod and one metallized rod was installed so that a comparison could be made. A stroke counter was affixed to each pump and results shown in the accompanying table were attained.

Table 1. Comparison of Metallized Pump Plunger and New Plunger

	Pump No. 1	Pump No. 2
Strokes	32,690	121,319
Metallized plunger worn (millimeters)	1.26	0.75
New plunger worn (millimeters)	1.82	1.60

Bearings may be babbitted by spraying Diesel marine or government genuine

Babbitt and finished by taking a light cut in a lathe. This application permits bearings to be repaired very rapidly and at low cost.

Another application that has been proved successful is the coating of valve pots in Dow hot oil pumps. There is a great deal of corrosion in the suction side especially in the valve pot which is nearest to the discharge. Replacement of these pots is a costly repair job. One large refinery in Oklahoma found it necessary to do something as their valve pots were becoming thin. They metallized them with 1/64 in. aluminum and put them back into service.

Authentic data taken from the engineering report of this company showing the wall thickness at various intervals both before and after metallizing illustrate the progress of the corrosion in one of the pots.

Table 2. Wear on Valve Pot of Hot Oil Pump

(Figures represent 64ths of an inch.)

	Suction Side	Discharge Side
Original thickness	76	76
After eighteen months	48	60
After thirty months	48	64
After forty-seven months (metallized)	40	60
After fifty-three months	41	58

Table 2 shows that after forty-seven months the valve pot was rapidly approaching the danger point and if the corrosion were not stopped, replacement would be necessary. At this time the pot was metallized with approximately 1/64 in. of aluminum. Six months after metallizing, examination showed a complete stoppage of corrosion. At the end of 1,264 hours of operation the aluminum was in the same condition as it had been at the six months period. The coating was in excellent condition and was serving its purpose to prevent corrosion.

Another application of metallizing in the oil industry is the coating of valves and plug cocks. Many refineries have effected considerable savings as a result of the timely application of metallizing.

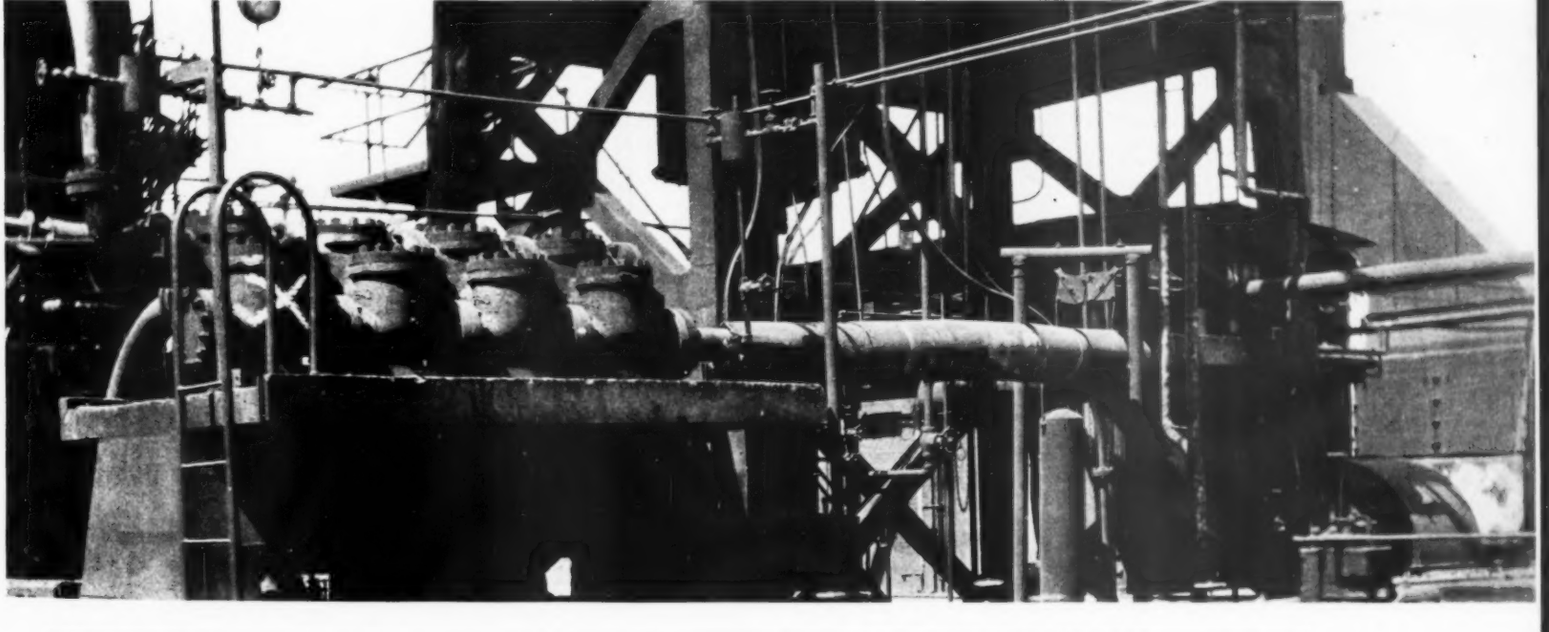
Coating acid treating tanks and storage tanks has been done extensively within recent months. Protective coatings have been applied in several instances to the floating roof type of tank. Originally, there was some doubt as to the success of such metallized coatings where the shoes rubbed up and down because of the concentrated pressures involved. Results have since shown that the constant rubbing of the shoes against the side of the metallized tank merely burnished the coating without causing damage. One instance is on record of an acid shell used in the continuous treatment of gasoline which was protected by lead spraying in April, 1933. The last report on this job was received in June, 1934, and at that time, there was no sign of leakage or deterioration of any kind. Tank cars, used in the shipment of gasoline, have been coated to prevent the discoloration of contents from rust during transportation.

In many parts of the country, the atmospheric corrosion of pipelines is an important factor. This may be prevented by spraying pipelines with zinc which will prolong their life indefinitely. An expense is involved in replacing thermocouple tubes and furnace tubes. Thermocouple tubes may be coated and their lives greatly prolonged. The high velocity of the oil going through furnace tubes wears out and corrodes return bends or tube ends. This necessitates replacing the entire tube which costs approximately $40 to $60. This expense may be avoided by spraying the inside of the return bends, and, in the course of a year, may more than repay the cost of the equipment. Tube sheets and heads in heat exchangers have been coated successfully by many refineries. Coating of blowers with lead is another application widely used in the oil industry.

Besides the uses that are mentioned here, there are many others. New uses are constantly being developed, and as these are proved successful, they will be generally adopted.

It is a significant fact that the companies either owning equipment or contracting a great amount of metallizing run through their units approximately 33 percent of all crude oil cracked in the United States. In a few states, the greatest percentage of crude oil cracked is by companies using metallizing. In Indiana, which includes nearly all of the Chicago area refineries, out of 158,200 bbl. cracking capacity, 143,200 bbl. is controlled by companies using metallizing.

Metallizing may be assumed to be past the experimental stage. Use in a large number of refineries has proved that



Coating the valve pots in Dow hot oil pumps, another metallizing application which has proved highly successful.

sprayed aluminum will withstand the high temperatures and severe corrosion from hydrogen-sulphide in crude oils. Its use is advisable not only from a corrosion standpoint, but also because it aids in the production of the cracking unit.

Table 3. Cracking Capacity of Plants Using Metallizing by States

State	Cracking capacity in barrels	Plants using metallizing: number of barrels cracked
Illinois	90,730	37,450
Kentucky	12,800	7,200
Ohio	69,800	21,900
Oklahoma	111,250	79,400
Pennsylvania	153,650	101,250
Texas	340,650	255,600

It does not decrease the inside diameter of the tower as much as the ganister lining and similar protective coatings. There is no danger of its falling off and forcing the refinery to cease production while the unit is being cleaned. Also, by merely painting the aluminum with a coat of whitewash, the coke may be more easily removed than before. Besides the coating of high pressure units, there are innumerable other uses around a refinery for metallizing equipment, a few of which already have been mentioned.

A chief engineer of one of the largest companies in the Mid-Continent and Texas oil fields recently reported to his superiors, "You will be able to save your company several thousand dollars per year in reclaiming and building up your old and worn equipment. This applies especially where you are handling high sulphur crudes, or crudes with a small amount of hydrogen-sulphide and hydrogen-chloride, also in your agitators and continuous treatment processes."

(The author wishes to thank the many refineries from whose reports the above data were taken. Time did not permit the author to obtain the permission of the refiners to publish their names. It is for that reason that their names are omitted.)

▼

New Taxes For Roumania

IN SPITE of internal and external difficulties the Roumanian oil industry has an appearance of being fundamentally sound and in what might be described as a flourishing condition. The figures for exports during the first six months of 1935 disclose the all-time record of 3,300,452 tons in comparison with any previous year for the same period. Taking 1926 as the base, 1935 shows a 9-fold increase in the exportation of fuel oil, 7-fold of gas oil, and 6-fold of gasoline, exports of kerosene and lubricating oils have been doubled. There is nothing in these figures to show that competition from Iraq or elsewhere has as yet had any effect in preventing an expansion of Roumanian oil exports. It is true that in 1930, when total exports were 1,742,544 tons, the combined values amounted to 5,226,839 Lei compared with the 3,852,946 Lei received for 3,852,946 tons in 1935, but the cash income from the export business is still larger than for the same period of any year since 1931. The fact that notwithstanding a doubling of production the income has been cut nearly in half is not, of itself, as serious as it may appear, because in recent years there has been a notable decrease in the average cost of production.

However, over against economies in field operations must be set the tendency for the national and local governments to increase their exactions in the way of taxes and various imposts. In any discussion of the economics of the Roumanian oil industry it will be useful to remember that it is the principal source of revenue for the Roumanian government, and that the government's budget shows a deficit of Lei 2,000,000,000–3,000,000,000. In their struggle against their deficit the taxing authorities have piled one oil tax on another, until in 1934 the treasury took about 48 percent of the value of all the oil produced, with the result that the margin of profit has generally disappeared and most of the companies are registering heavy deficits.

Notwithstanding the financial difficulties in which the oil producers find themselves, the government is still displaying much pertinacity and ingenuity in thinking up new ways of mulcting the industry. The latest of these is the Leon project, which is being considered as the basis of a new law, which will include the following features:

(a) A single tax on the crude before its treatment in the refineries (which it is asserted would simplify the control and increase the revenue by about Lei 300,000,000 per annum); (b) an agreement with the railway company for the establishment of single transport tax throughout the Roumanian territory without consideration for distance; (c) installation of depots and outlets over the whole national territory so as to promote consumption; (d) compulsory limitation of the quantities of products to be distributed by every company in order to preserve a proper margin for the national companies. The report urges wider government authority to rationalize production, to nationalize oil lands, to regulate distribution and prices, to control foreign currency resulting from exports and to provide for the government's refining of its own crude.

The single tax on crude is theoretically very ingenious. It is simple and it is "unique." But its very simplicity bars its practical application. There are two main difficulties: the variety of the crudes and of cracking. Let us take as examples the yields of various crudes on distillation:

	Bustenari Light Crude	Gura Ocnitei Paraffinic Crude	Moreni Extra Heavy Crude
Light motor spirit	17%	12.5%	5%
Heavy motor spirit	5%	3%	5%
Kerosine	28%	25%	20%
Gas oil	7%	9%	7%
Fuel oil	35%	42.5%	55%
Loss	8%	8%	8%
Total	100%	100%	100%

It is shown by these figures that the yield varies very much according to the oil field. Even in the same oil field the yield varies from well to well, according to the geological strata.

Cracking adds a new difficulty. The cracking crude gives one basis of calculation (the motor spirit yield which is the most heavily taxed, being increased considerably), the non-cracked, another. Moreover, the cracked crudes themselves admit a wide scale of bases (the Roumanian crudes yield by cracking from 25 percent to 55 percent motor spirit).

The single tax is obviously obtained in the following manner:

Percent motor spirit	× actual tax on motor spirit	= w
Percent kerosene	× actual tax on kerosene	= x
Percent gasoil	× actual tax on gasoil	= y
Percent fueloil	× actual tax on fueloil	= z
100% crude	= single tax	= w+x+y+z

But, as the percentage varies continuously, the sum w+x+y+z changes and therefore also the single tax. It is possible to fix an average tax on an average crude, but such taxation is not equitable and does not attain the proposed aim of protecting small enterprises. Indeed, the average tax would be heavier on the non-cracked products and consequently more burdensome to the small enterprises which have no cracking plants.

But there is another detail: The export crudes and products are not taxed on the consumption, which is an interior tax. Therefore, there are two formalities to be fulfilled by the companies, which are both producers and exporters: Payment of the single tax at the entrance to the refineries and collection of the same tax at the export point (although it is very difficult to know exactly what quantity of crude is supposed to have yielded the exported products).

The commercial objection to maintaining identical prices in all parts of the country, regardless of transport costs, is obvious. It is natural that oil in Bucharest should be cheaper than in the provinces. As for increasing number of outlets, there is a limit established by commercial efficiency. Even today the consumption tax law provides that every depot shall keep in store, without any commercial consideration as to the amount of sales, all existing petroleum products. Any further non-commercial arrangements will surely add new difficulties to a private undertaking quite unable to cope with such additional burdens.

World Oil Production—Official Figures for 1934 and 1935 Revised

All figures furnished direct to WORLD PETROLEUM by Governments, except where otherwise specified

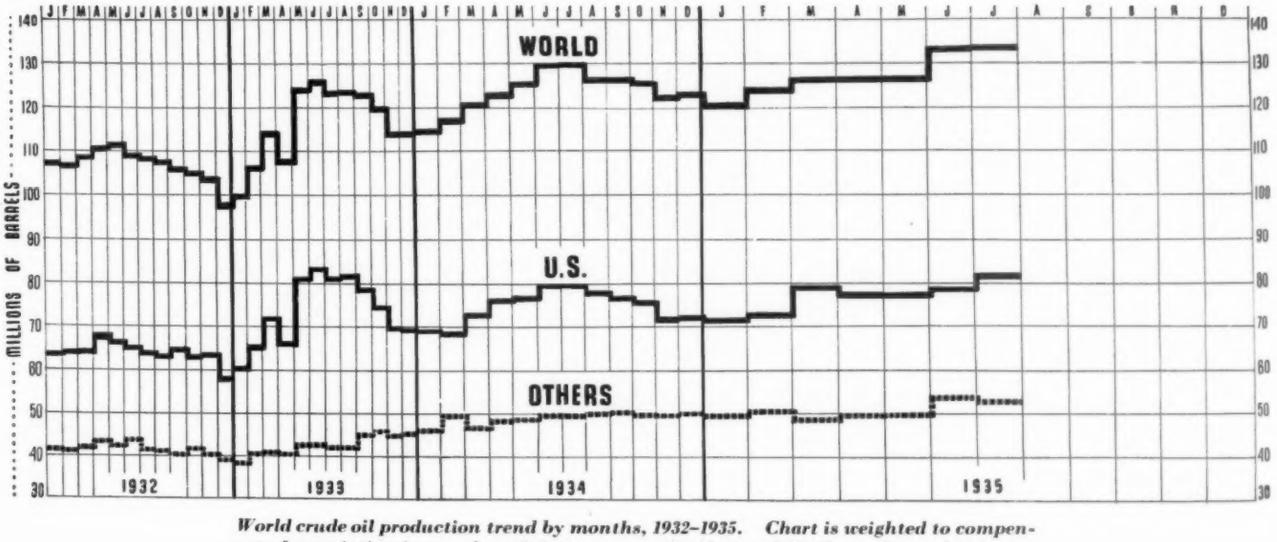
(Figures in U. S. Barrels—Conversion ratio 7 bbl. = 1 ton)

Country	August 1934	September 1934	October 1934	November 1934	December 1934	January 1935	February 1935	March 1935	April 1935	May 1935	June 1935	Provisional Figures July 1935
United States	79,058,000	75,810,000	76,776,000	72,463,000	74,772,000	78,715,000	72,763,000	81,488,000	78,427,000	82,454,000	82,338,000	85,072,000
Russia	14,287,700	13,924,400	14,260,000	14,388,500	14,638,400	13,358,100	12,704,300	14,139,300	14,058,200	14,280,000[1]	14,150,000[1]	14,050,000
Venezuela	12,505,304	12,381,159	12,591,390	12,274,794	12,420,296	12,818,414	11,287,605	11,703,825	11,869,900	12,175,022	13,075,118	13,429,885
Iraq[5]	12,006,127	11,618,510	12,006,127	11,618,510	12,006,127	425,000	1,631,000	2,258,123	556,500[1]	1,085,000[1]	4,200,000[1]	1,739,348
Roumania	5,556,000	5,335,000	5,467,000	5,324,000	5,522,000	5,355,000	4,860,000	5,256,000	5,008,000	5,035,000	4,842,000	5,296,350
Iran[2]	4,886,462	4,955,419	4,499,530	3,725,178	4,049,556	4,410,714	4,109,665	4,879,000	4,088,000	3,927,000	4,264,480[1]	3,798,032
Mexico	3,434,516	3,276,612	3,393,770	3,332,926	3,425,314	2,894,167	2,661,632	3,519,148	3,120,035	3,529,659	3,453,871	3,284,760
Netherland India	3,456,215	3,410,785	3,577,399	3,353,067	3,743,810	3,618,272	3,244,717	3,539,564	3,438,848	3,517,360	3,463,061[1]	3,507,030
Colombia[4]	1,691,314	1,627,632	1,646,293	1,633,654	1,554,172	1,653,647	1,141,696	1,466,821	1,377,299	1,486,896	1,518,460	1,639,054
Argentina	1,210,273	1,258,812	1,271,186	1,283,811	1,173,998	1,114,235	1,107,420	1,260,468	1,514,968	1,203,017	1,161,638	1,282,346
Peru[4]	1,470,010	1,415,189	1,485,309	1,340,115	1,420,247	1,418,320	1,269,077	1,395,532	1,329,215	1,451,436	1,414,588	1,277,076
Trinidad	975,697	919,469	906,152	907,655	930,877	915,220	843,619	919,848	899,946	953,108	972,904	942,772
British India	762,959	752,451	779,011	763,091	746,410	781,170	708,159	773,572	700,000[1]	700,000[1]	700,000[1]	700,000
Poland	320,145	311,003	315,000	308,000	308,000	307,000[1]	297,000[1]	309,000[1]	330,000[1]	340,000[1]	314,490[1]	324,973
Brunei	263,781	246,554	225,561	227,815	258,909	269,794	241,927	264,390	267,603	277,550	269,290	283,430
Sarawak	161,504	155,400	156,800	152,600	158,200	183,300	136,500	152,250	151,067	155,400	150,850	151,830
Japan	129,326	124,870	125,229	119,970	131,059	171,441	151,797	164,174	167,728	154,150	157,738[1]	170,004
Egypt	131,061	124,502	123,235	116,326	115,731	112,147	100,086	104,419	94,935	100,535	99,260	103,488
Ecuador	140,944	136,033	141,079	133,490	140,000	147,315	139,535	151,366	145,212	147,245	137,806	144,812
Canada	114,778	114,242	122,056	113,228	117,113	124,654	111,545	120,537	108,506	122,636[1]	120,102	120,900
Germany[3]	219,961	198,366	227,605	219,485	228,767	287,518	223,153	277,942	240,464	285,747	257,369	265,856
France	46,000[1]	46,000[1]	46,000[1]	46,000[1]	46,000[1]	43,078	34,510	44,191	46,284	46,991	46,000	46,000
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	142,903,077	138,217,408	140,216,732	134,120,215	137,981,986	129,198,506	119,842,963	134,262,470	128,014,730	133,502,772	137,182,025	137,704,946

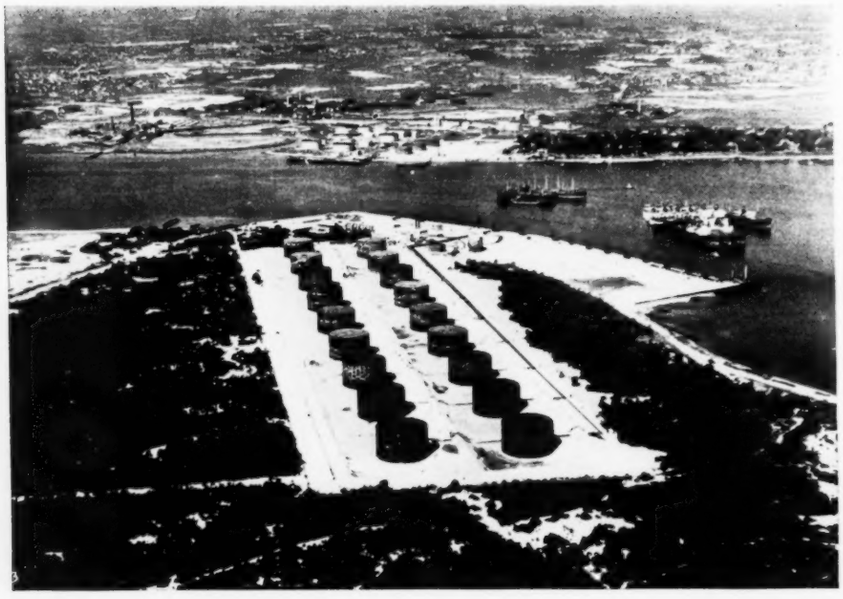
[1] Estimate. [2] Anglo-Persian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] Thuringia estimated 7,000 bbl.; official figure for Prussia. Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan. [4] International Petroleum Company's figures. [5] Iraq production estimated for 1934 on basis of total year's production represented by oil shipments through Tripoli and Haifa starting January 1935 plus oil necessary to fill line initially. [6] International Petroleum Company and Lobitos Oilfields Ltd. figures.

Official Crude Oil Production Figures for 1932 to 1935

Country	Total 1935 to July 31	Daily Average 1935 to July 31	Total 1934	Daily Average 1934	Total 1933	Daily Average 1933	Total 1932	Daily Average 1932
United States	561,257,000	2,647,468	909,107,000	2,490,704	898,874,000	2,462,670	785,159,000	2,145,243
Russia	96,739,900	456,320	168,648,700	462,031	149,901,900	407,950	149,719,000	409,070
Venezuela	86,359,769	407,357	142,072,329	389,239	120,882,802	331,186	119,596,512	326,766
Iraq	11,894,271	56,105	71,921,468	6,607	1,200,000	3,288	1,200,000	3,300
Roumania	35,652,350	168,171	62,006,000	169,879	50,971,200	139,647	50,491,205	137,954
Iran	29,476,891	139,051	52,663,782	144,284	49,581,280	135,840	45,122,435	123,285
Mexico	22,463,272	105,959	38,167,022	104,567	33,904,882	92,890	32,802,285	89,624
Netherland India	24,328,852	114,759	42,289,408	115,861	38,512,663	105,516	39,584,027	108,153
Colombia	10,283,873	48,509	17,340,724	47,509	13,157,127	36,047	16,384,956	44,768
Argentina	8,644,092	40,774	14,045,652	39,015	13,759,565	38,232	13,166,900	35,975
Peru	6,447,417	30,412	15,936,937	43,663	13,923,281 −	38,146	9,899,266	26,026
Trinidad	5,062,901	23,882	10,894,363	29,847	9,560,039	26,192	10,023,780	27,387
British India	2,222,463	10,483	8,997,399	24,650	8,721,655 +	23,893	8,600,312	23,500
Poland	1,873,984	8,840	3,697,617	10,130	3,858,085 −	10,570	3,905,230	10,670
Brunei	1,081,197	5,100	2,673,041	7,323				
Sarawak	1,137,032	4,563	1,948,044	5,337	2,289,472 −	6,273	2,274,043	6,213
Japan	714,910	3,372	1,484,962	4,068	1,377,761	3,827	1,575,333	4,375
Egypt	1,013,311	4,780	1,479,037	4,052	1,591,493	4,360	1,742,370	4,760
Ecuador	828,880	3,910	1,655,062	4,534	1,622,624 −	4,446	1,573,857	4,300
Canada	1,838,049	8,670	1,418,810	3,887	1,147,825 −	3,144	1,054,373	2,880
Germany	307,054	1,458	2,266,964	6,211	1,712,823	4,692	1,824,019	4,983
France			552,000	1,512	552,000	1,515	552,000	1,508
Bahrein	525,000	2,476	285,071	781				
Others			861,000	2,359	432,000	1,184	432,000	1,180
	919,708,412	4,338,247	1,502,617,452	4,117,293	1,417,534,489	3,884,022	1,296,712,823	3,544,940



World crude oil production trend by months, 1932–1935. Chart is weighted to compensate for variation in number of days per month. Ratio of U. S. crude production to world production.



Air view of Port Socony in New York harbor, a recently completed, entirely modern marine oil terminal.

SHIPPING

PORT SOCONY, one of the world's most modern marine oil terminals, located on Staten Island, New York harbor, was officially opened on July 18. The largest type tanker can dock at Port Socony which has six groups of connections for tankers and eight for barges, storage capacity for over 10,000,000 gal. gasoline, 26,000,000 gal. fuel oil, 10,000,000 gal. range oil and 18,000 gal. lubricating oil. The entire installation is equipped with the most modern and effective type fire fighting system. In addition there are 2,800 ft. of paved roadway and sixteen steel framed houses.

THE ALL-WELDED tanker MOIRA may well be significant of a new trend in shipbuilding and for that reason her construction is being followed with interest in shipping circles.

This ship which is at present under construction at the Wallsend Shipyard of Swan, Hunter and Wigham Richardson, Ltd., has a length between perpendiculars of 245 ft., extreme breadth of 42 ft. 3 in. and moulded depth of 18 ft. Designed for a total deadweight of of about 2,240 tons on a mean draft of 16 ft. 4½ in. in salt water her loaded trial speed is 10 knots.

The engines are placed aft and consist of a

Welding with Quasi-arc the plates on the all-welded tanker Moira.

steam reciprocating engine of compound expansion direct-acting surface condensing marine type, in conjunction with which a Bauer Wach exhaust steam turbine installation is arranged. Two single ended boilers of cylindrical multitubular type fitted for burning coal or oil fuel with Howden's forced draught provide steam at a working pressure of 210 lbs. per square inch. Cargo compartments consist of five main oil compartments subdivided by a longitudinal bulkhead on the centre line. The pump room, which is arranged between the third and fourth tank from forward, contains two oil cargo pumps, each capable of delivering 200 tons per hour The steering gear is of electric hydraulic type.

With regard to the welding and layout for erection, the keel and bottom shell plates were laid separately on the berth and faired up, all joints were butt welded, the plates being veed 60 deg. on the upper edge. Thus, the greater part of the welding was carried out in the down over position, the closing weld on the apex of the vee only being welded in the overhead position.

The whole of the inner bottom plating complete with longitudinals, floors and centre girder was welded in large panels on the skids, each complete panel weighing between seven and twelve tons, all joints being butt welded.

The midship side shell, inner shell and deck were treated in a similar manner. Flush butts formed the joints of the side shell with the exception of the sheer strake and bilge strake. These two strakes were overlapped longitudinally, the transverse butts being flush.

The transverse bulkheads were completely flush welded on the skids, and lifted whole into position on the ship, the shell and decks were welded direct to the bulkheads, no boundary angles being fitted.

The longitudinal centre line bulkhead was similarly treated, panels about 26 ft. long being welded complete and lifted into position and welded direct to shell and deck.

The shape of the vessel necessitated the erection and welding of the shell at forward and after ends, plate by plate. The plates were set to shape, edges veed, lifted into position and tack welded to frames and adjoining plating.

No rivets were used in the construction of this vessel and no holes punched in plates or bars for fairing or erection purposes. Wherever necessary lugs or bolts spot welded served this purpose, these being chipped off when welding was completed. Quasi-arc mild steel and uranium electrodes were used.

THE NEW Diesel motor tanker OELSCHINDLER built for the tanker subsidiary of Oelwerke Julius Schindler, Hamburg, has just been completed.

This vessel has a cargo carrying capacity of about 2,000 tons, and a draft of only 14 ft. It is intended particularly for the trade from Europe to the Canadian Lakes.

The boat has been chartered for two palm kernel oil trips from Nigeria to Europe and/or United States, and the first cargo will be discharged in Chicago.

The interests of Oelwerke Julius Schindler are represented in the United States by S. Schwabacher and Company, New York.

UNITED STATES

	Daily Crude Oil Production bbl.	Daily Runs to Stills bbl.	Total Motor Fuel Stocks bbl.	Imports for week bbl.	California Shipments East for Week bbl.
Week ending July 20	2,766,500 494,000*	2,760,000	60,177,000	713,000**	490,000
Week ending July 27	2,747,000 473,000*	2,825,000	60,084,000	997,000**	None
Week ending Aug. 3	2,660,000 468,000*	2,645,000	60,101,000	1,163,000**	192,000

Underlined figures indicate improvement in statistical position—decrease in production, runs to stills, gasoline stocks and imports.

*Estimated total production of the East Texas Field, official and unreported.

**Import figures include all oil imported, for domestic use and in bond for re-export, it being impossible to make the separation in weekly statistics.

Interstate Compact Approved

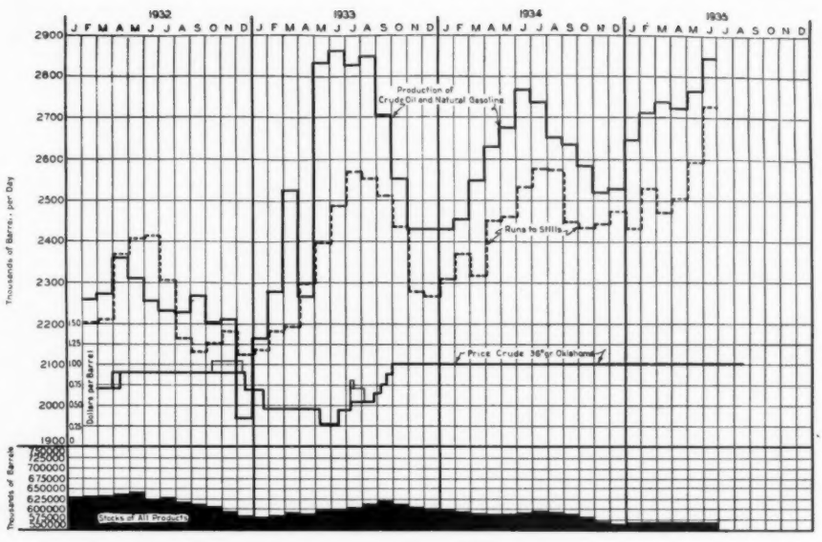
THOUGH it is generally conceded that no legislation of any kind affecting the oil industry will be passed during the current session of Congress, President Roosevelt, on August 9 sent a message to Congress, recommending the approval of the interstate compact in the following statement: "I transmit herewith a certified copy of the state compact to conserve oil and gas, executed in the city of Dallas, Texas, on February 16, 1935, by the representatives of the states of Oklahoma, Texas, California, and New Mexico, and recommended for ratification by representatives of the states of Arkansas, Colorado, Illinois, Kansas, and Michigan. The compact, signed by representatives of these states, has been deposited in the Department of State of the United States. I also transmit a report of the Secretary of State, from which you will observe that notification has been received by the Department of State of the ratification of

Gulf Export Prices for Major Oil Products

	Products	Cents per Gallon				
		June 17	July 2	July 16	July 30	Aug. 14
Gasoline:	U. S. Motor	5½	5	5	4⅞	4⅞
	64/66-375 E. P.	5¼	5⅛	5¼	5⅛	5⅛
	59 Oct. & below	5¼	5¼	5¼	5¼	5¼
	65 Oct. & above	5½	5½	5½	5½	5½
Aviation Gasoline:	73 Oct. & above	9½	9½	9½	9½	9½
Kerosene:	44 w.w.	4¼	4¼	4¼	4¼	4¼
	41-43 w.w.	4	3⅞	3⅞	3⅞	3⅞
	41-43 p.w.	3⅞	3⅞	3⅞	3⅞	3⅞
Gasoil:	26-30 transluse.	2⅞	2⅞	2⅞	2⅞	2⅞
	30 plus transluse.	3⅛	3⅛	3⅛	3⅛	3⅛
Fuel Oil:	Bunker purposes (per bbl.)	$1.00	$1.00	$ .90	$ .90	$ .90
Grade C:	Cargo lots (per bbl.)	$ .80	$ .80	$ .78	$ .75	$ .70
	Diesel oil (per bbl.)	$1.70	$1.50	$1.50	$1.50	$1.50
Lubricating Oil:	Bright Stock No. 8	24	24	24	24	24
(New York Export Market)	Bright Stock No. 6½	23½	23½	23½	23½	23½
	Warren E	20	20	20	20	20
	600 Unfilt.	16½	16½	16½	16½	16½
	650 Unfilt.	18	18	18	18	18
	600 Flash s.r.	19	19	19	19	18½
	630 Flash s.r.	24	24	24	24	24
	Neutral 200 No. 3	28½	28½	28½	28½	28½
	Neutral 150 No. 3½	23½	23½	23½	23½	23½
So. Texas:	300 No. 3 pale	7	7	7	7	7
	500 3½ pale	7⅞	7⅞	7⅞	7⅞	7⅞
	750 4 pale	9	9	9	9	9
	1200 4 pale	9½	9½	9½	9½	9½
	500 No. 5-6 red	7⅞	7⅞	7⅞	7	7⅝
	750 5-6 red	9	9	9	9	9
	1200 5-6 red	9½	9½	9½	9½	9½
Crude Oil:	East Texas crude delivered at Gulf port for Export	$1.18	$1.18	$1.16	$1.17	$1.18
	Venezuela crude	.83	.83	.83	.83	.83
	Trinidad crude	.85	.85	.85	.85	.85
	Panuco crude	.97	.95	.95	.95	.95

the compact by the legislatures of Kansas, Oklahoma, Illinois, Colorado, and Kansas. I recommend that the Congress enact legislation giving the consent of Congress to the state compact to conserve oil and gas. . . ."

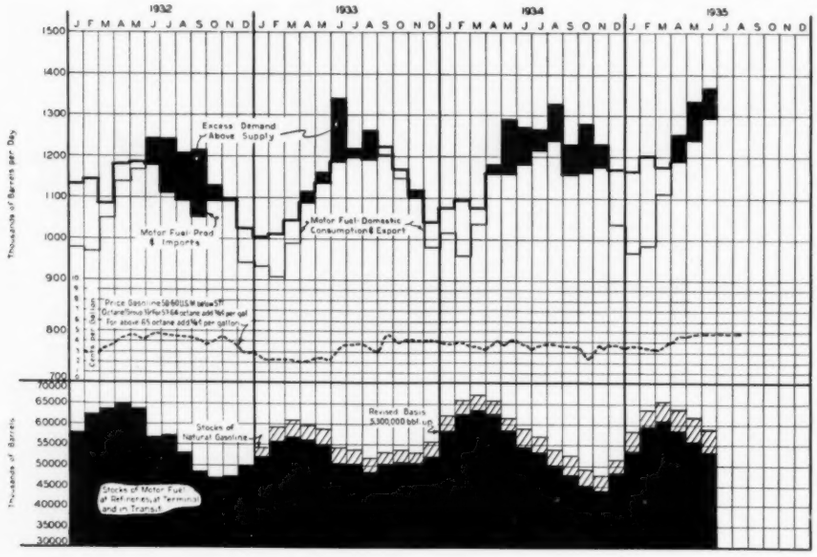
Following the message of the President, two bills were submitted to Congress, one in the Senate by Senator Thomas, and one in the House of Representatives by the subcommittee headed by Representative Cole, which last year conducted an extensive inquiry into the industry. But while President Roosevelt limited his recommendation to the approval of the interstate compact without any further provisions, the two bills submitted in Congress provided for the creation of a federal petroleum administrative board of five members, to be appointed by the President, which is to be authorized to examine supply and demand within the oil industry and to make recommendations for production quotas; also empowering the President to limit imports of crude oil and its products, and providing for the unlimited extension of the Connally contraband oil act, which is now limited to two years. The proposed board, while reporting directly to the President, may be, with the President's approval, transferred to the Department of the Interior, now under Harold L. Ickes, a feature which is meeting with widespread objection, not only in the oil industry, but also in Congress. Moreover, it is generally felt that such a petroleum administrative board of five members, which carries provisions for $10,000 to $12,000 salary each, is entirely unnecessary, inasmuch as the Bureau of Mines is fully equipped to render this service to the industry; furthermore, such a board would provide an entering wedge into the oil industry for the federal government, and this is objected to equally by the industry and by the states. Therefore, it was generally acknowledged that neither the Cole nor the Thomas bill had much chance of passage during the remainder of the current session, and in order to meet with the desires of the industry and President Roosevelt to see the



U. S. production, runs to stills and price of crude oil in relation to stocks of all petroleum products.

current session of Congress approve only the interstate compact, Senator Tom Connally, Democrat-Texas, has introduced in the Senate a substitute for the Thomas oil bill, merely ratifying the oil states compact, providing machinery for control of oil imports through a tariff commission, and the Chief Executive, and making permanent the Connally contraband oil act. It is considered that the new Connally bill may have a fair chance of passage through Congress, having been passed by the Senate on August 14, inasmuch as the proponents of the more extreme control of the industry have given up hopes for this session and have adopted a policy of waiting and hoping that the states will not be able to control production and accordingly forcing stricter federal control during the next session of Congress.

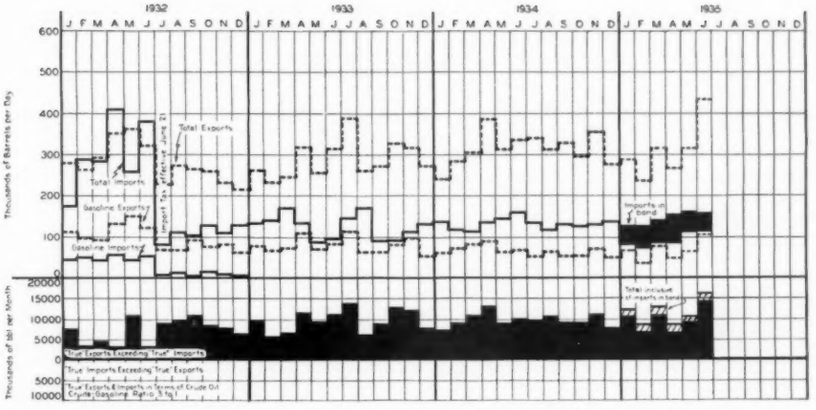
U. S. production and imports, consumption and exports and price of motor fuel in relation to motor fuel stocks; showing excess daily demand over supply by black areas.


1932
1933
1934
1935
J F M A M J J A S O N D
Thousands of Barrels per Day
Excess Demand Above Supply
Motor Fuel Prod & Imports
Motor Fuel Domestic Consumption & Export
Cents per Gal
Price Gasoline 56 60 U.S.M. octane 3¢
Octane 3 mos. 1st to 31-64 octane add 1/6¢ per gal
For above 65 octane add 1/4¢ per gallon
Revised Basis 5,300,000 bbl. up
Stocks of Natural Gasoline
Stocks of Motor Fuel at Refineries, at Terminals and in Transit
Thousands of Barrels

Prices Continue Strong

DURING the past month crude oil and gasoline prices remained unchanged and strong, while retail prices at service stations improved in several large marketing centers due principally to high seasonal consumption. The future trend is anticipated to be definitely strong with the strict enforcement of state proration orders in Texas and Oklahoma, while recent developments in California indicate that that state also will reduce its production to conform more closely with demand. The unknown factor at present is the state of Louisiana with its recently discovered deep production in the Rodessa field, but even there it is quite generally admitted that Senator Huey Long will enforce strict proration, because of his presidential aspirations in an effort to make the best possible impression, not only on the oil industry but also on the large class of fee-landowners, who would be adversely affected by overproduction in the Rodessa field with resulting demoralization of crude oil prices. The situation in Texas continued strong with the state eliminating the last traces of overproduction, with East Texas currently overproducing only about 30,000 bbl. per day, a quantity which does not greatly affect retail motor fuel prices outside of the immediate area of the East Texas field, and then only those of third grade gasoline.

During the past month refinery gasoline quotations remained unchanged, while motor fuel prices at service stations were generally stronger with the elimination of price wars in several large marketing areas of the United States. The dominating influence during July and August was the extremely heavy seasonal movement of motor fuel to the consumers, favored by excellent weather conditions throughout the country and by the


1932
1933
1934
1935
J F M A M J J A S O N D
Thousands of Barrels per Day
Total Exports
Total Imports
Import Tax effective June 21
Gasoline Exports
Gasoline Imported
Imports in bond
Thousands of bbl. per Month
Total imports of imports in bond
True Exports Exceeding True Imports
True Imports Exceeding True Exports
True Exports & Imports in Terms of Crude Oil
Crude-Gasoline Ratio 3 to 1

Total U. S. imports and exports and gasoline exports, indicating imports in bond; and showing evaluation of true exports exceeding true imports.

vacation season. Natural gasoline prices strengthened somewhat during the past month in anticipation of fall demand and because of the curtailment of production in Texas under recently passed gas conservation laws.

Posted crude oil prices during August remained firm and unchanged at $1.00 per barrel for 36 gravity Mid-Continent crude, and $1.00 flat per barrel for East Texas crude.

Tank wagon/service station motor fuel prices per gallon, regular grade, including all taxes, in representative districts in the middle of August were: 15.05/19.3 cents in metropolitan New York (13.3/16.8 cents in Newark, N. J.); 13.0/16.5 cents in Boston, Mass.; 12.0/13.5 cents in Providence, R. I.; 15.5/17.5 cents in Chicago; 17.0/19.0 cents in Ohio; 16.5/18.5 and 11.5/13.5 cents in San Francisco and Los Angeles respectively, with some independents selling third grade motor fuel for as low as 10.0 cents per gallon in Los Angeles, all taxes included; 16.0/18.0 cents in Oklahoma; 15.0/17.0 in Dallas, Forth Worth and Houston, Texas, with third grade product from East Texas selling locally down to 10 cents per gallon by independent stations; 15.2/17.2 cents in St. Louis and East St. Louis; and 20.5/23.0 cents in Montreal, Canada; all with a 2-cent differential for premium grade.

Refinery gasoline quotations in the Mid Continent area remained unchanged during the past month. Refinery gasoline was quoted on August 15 at 4¾–4⅞ cents per gallon for 58–60 U.S.M. grade 62.9 and below octane rating in Group 3, Oklahoma market; 63.0–70.9 octane rating, U.S.M., regular grade, was quoted at 5⅝–5¾ cents per gallon; and 71 and above octane rating, U.S.M., premium grade was nominally quoted at 5¾ cents per gallon. East Texas markets remained with prices on par with Group 3 quotations. On the East Coast, at Bayonne, U.S.M., grade 60.0–64.9 octane rating gasoline was quoted slightly higher at 6.0 cents per gallon (3.54 cents gold*). Gulf Coast prices for export declined ⅛ of a cent per gallon below July 20 quotations and on August 15 were around 4⅞ cents per gallon (2.88 cents gold*) for grade 58–60 U.S.M.

Natural gasolines further firmed up during July and early August with the approach of fall demand and due to curtailment of production in Texas under new state regulation for the conservation of gas. On August 15 grade 26–70 was quoted at 3⅜ cents per gallon (1.98 cents gold*) in Oklahoma; at 3–3¼ cents per gallon (1.85 cents gold*) in North Texas; and 3½ cents (2.07 cents gold*) in North Louisiana.

Kerosene prices remained unchanged during the past month. On August 15th grade 41–43 w.w. quoted at 3⅜–3⅝ cents per gallon in Group 3, Oklahoma market; and at 4⅞–5 cents per gallon (2.88 cents gold*) on the East Coast at Bayonne. Gulf Coast prices for export remained unchanged at 3⅞ cents per gallon (2.29 cents gold*) for 41–43 p.w. grade and at 3⅞–4 cents per gallon (2.36 cents gold*) for 41–43 w.w. grade.

Exports Increase Sharply

DURING June, 1935, total gross imports of all petroleum products into the United States amounted to 4,836,000 bbl., 161,000 bbl. per day, as compared with 5,074,000 bbl., 163,600 bbl. per day, imported during the preceding month; out of this total during June, 1935, 3,478,000 bbl., 116,000 bbl. per day, were imported for domestic use and 1,358,000 bbl., 45,200 bbl. per day, were imported in transit either for refining and re-export or for use in vessels in foreign trade. During the preceding month, May of 1935, 3,525,000 bbl., 113,800 bbl. per day, were imported for domestic use and 1,549,000 bbl., 49,800 bbl. per day, were imported in bond as indicated above. The crude oil imported for refining and re-export amounted in June, 1935, to 293,000 bbl. Therefore during June the net imports of 116,000 bbl. per day for domestic use were somewhat in excess of the federal recommendation of 108,400 bbl. per day, though the average for the first six months of 1935 was but 94,500 bbl. per day, or well within the desired volume.

Exports of all petroleum products during June, 1935, increased 37.20 percent above the daily rate of the preceding month, reaching 12,951,000 bbl., 431,000 bbl. per day, as compared with 9,746,000 bbl., 314,000 bbl. per day, shipped during May, 1935. The June, 1935, total exports were also 31.0 percent in excess of the shipments in June of 1934 when 9,851,000 bbl., 329,000 bbl. per day, were exported. For the first six months of 1935, the total exports of 56,037,000 bbl. exceeded slightly the exports during the same period of 1934 when 55,963,000 bbl. were shipped. Exports of crude oil from the United States during June, 1935, were again very high reaching 5,589,000 bbl., 186,000 bbl. per day, as compared with 3,795,000 bbl., 126,400 bbl. per day, shipped in June of 1934. In May of 1935 crude oil exports constituted 43.1 percent of the total exports of all petroleum products. During the first six months of 1935 crude oil exports reached 22,432,000 bbl. as compared with 18,842,000 bbl. shipped in the same period of 1934, an increase of 19.05 percent.

* U. S. dollar at 41 percent discount.

Production and Runs to Stills

CRUDE oil and natural gasoline production during July, 1935, the second month of operations without the federal regulation under the N.R.A., averaged about 2,875,000 bbl. per day, 26,000 bbl. per day above the crude oil and natural gasoline production during the preceding month when 2,849,000 bbl. per day were produced; and it was also about 145,000 bbl. per day above crude oil and natural gasoline production in June of 1934, an increase of 5.30 percent. The July, 1935, average daily crude oil production exceeded the federal recommendations by about 100,000 bbl. per day, the bulk of overproduction again being in California, which exceeded its quota by some 1,240,000 bbl., while Texas overproduced 610,000 bbl. Kansas underproduced 220,000 bbl. during July and Oklahoma underproduced 100,000 bbl. during the same month. Thus, crude oil production exceeded the recommended economic quota by about 100,000 bbl. per day during July and same excess continued during the first half of August. Maintenance of crude oil prices during the balance of 1935 will depend entirely upon the ability of oil producing states to curtail production down to the demand, and while it is very much hoped

Effect of Federal Proration Recommendations in Principal Oil Producing States

	Sept. 1933 to July 1935 Cumulative Overproduction		July 1935 Over-production	August 1935 Federal Recommended Quota	Daily Average Production for week ending	
	bbl.	% of total	bbl.	bbl.	August 3 bbl.	August 10 bbl.
Texas	38,395,000	53.7	610,000	1,024,000	1,038,500	1,045,000
Oklahoma	10,340,000	14.4	*	512,000	499,000	496,500
California	10,378,000	14.4	1,240,000	510,000	549,000	588,000
Kansas	2,243,000	3.1	**	148,000	146,000	139,500
United States	71,502,000	100.0	2,250,000	2,600,000	2,660,000	2,701,500

*Oklahoma underproduced 100,000 bbl. in July.
**Kansas underproduced 220,000 bbl. in July.

that this will be achieved, more effective control in California is obviously imperative, while hot oil production in East Texas must be reduced from current volume of around 35,000 bbl. per day; furthermore, Louisiana with its recent flush discovery at Rodessa and unknown political set-up is strategically in position to upset the markets during the coming fall and winter when wells now starting will be completed.

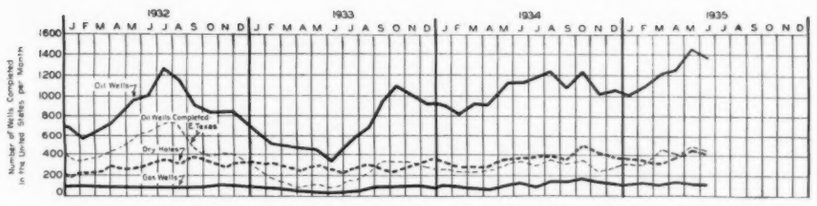
Crude oil runs to stills during June, 1935, averaged about 2,750,000 bbl. per day, or some 26,000 bbl. per day above the runs to stills during the preceding month when 2,724,000 bbl. per day were refined.

Total stocks of all petroleum products declined during June, 1935, by 287,000 bbl. to a total of 568,053,000 bbl., indicating daily gross withdrawals of 9,560 bbl.

Motor Fuel Demand High

INDICATED domestic demand for motor fuel during June, 1935, averaged 1,263,000 bbl. per day, an increase of 1.59 percent above the daily average during May, 1935, when 1,261,000 bbl were consumed per day; the domestic demand during June, 1935, was 43,900 bbl. per day above the domestic motor fuel consumption in June of 1934, an increase of 3.60 percent; 73,000 bbl. per day above the adjusted domestic motor fuel consumption in June of 1933, an increase of 6.13 percent, but 33,000 bbl. per day under the adjusted domestic motor fuel consumption in June of 1931, the peak year before 1934, a decrease of 2.55 percent. The motor fuel demand during June of 1935 was very considerably handicapped by unfavorable motoring conditions due to unseasonable weather which became normally favorable in July.

The NEW YORK TIMES weekly combined business index advanced substantially to 86.9 in the week ending August 3, 1935, from the July average of around 85. The NEW YORK TIMES index stood at 75 on August 1, 1934; at 87 on Augus. 1, 1933, just as it started down after the brief uprush and before it slipped to 78 by September 1, 1933; at 65 on August 1, 1932; and at 82 on August 1, 1931. The continued retarding influence on business was the fact that Congress was still in session with a number of bills of questionable value and constitutionality before it, though with the recess in sight and definite indications that the country is turning away from New Deal legislation, together with the marked improvements in general business conditions throughout the world, considerable advance in business activity in the United States is anticipated for early fall.



U. S. drilling statistics: comparison of oil wells, gas wells and dry holes, with separation of oil wells in the East Texas field.

The daily rate of exports of motor fuel increased very sharply to 107,000 bbl. in June, 1935, 55.0 percent above the preceding month; 55.90 percent above motor fuel exports in June of 1934; 22.5 percent above motor fuel exports in June of 1933; an 1.65 percent under motor fuel exports in June of 1931.

On July 1, 1935, motor fuel stocks at refineries, plants, terminals and in transit, inclusive of natural gasoline, amounted to 58,992,000 bbl., a decline of 2,181,000 bbl. as compared with stocks on hand on June 1, 1935, indicated that during June motor fuel demand exceeded supply by 72,600 bbl. per day.

Louisiana—Rodessa

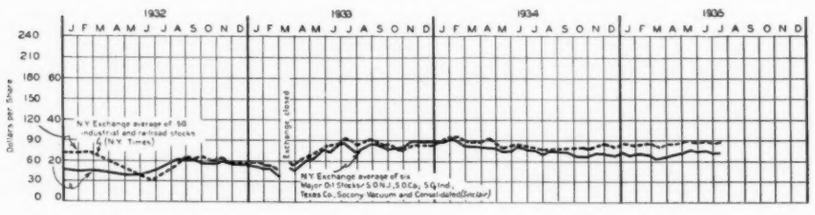
THE UNITED Gas Public Service Company's No. 1 I. L. Young in section 21, T. 23 N., R. 16 W. in Caddo Parish, the well that discovered flush oil production in Rodessa field, is currently producing 3,260 bbl. per day through ½-inch choke, the crude oil being run by the Standard Oil Company of Louisiana (S.O.N.J.). The United Gas Public Service Company's No. 1 D. F. Barr in section 29, 1½ miles due southwest from No. 1 Young, was completed during the past month for 58,000,000 cu. ft. of gas at 6,052 ft. proving to be apparently above the gas-oil contact level; structurally No. 1 Barr correlated some 75 ft. higher than No. 1 Young. Similarly Haynes Production Company's No. 1 Tyson in section 24 and 2½ miles due east from No. 1 Young now drilling at around 5,500 ft. is correlating some 150 ft. higher than the discovery well and is considered as only a gas well. Several wells are now drilling down the dip from the discovery and should prove important extensions in the coming few months.

The active play in the new area currently extends from Arkansas, through Louisiana near Rodessa, and into Texas, along a projected fault, for a distance of some 30 to 40 miles. Parallel faults are being studied due northwest from the Rodessa-Jefferson fault, and six seismograph crews are now working in the area.

The State of Louisiana promulgated regulations in regard to allowable production in the future to be based 75 percent upon acreage and 25 percent upon potential, not limiting drilling operations in any way otherwise. Production of the discovery well has not been officially curtailed, though it was indicated that the state will issue proration orders when new wells are brought in.

It is generally conceded that the Rodessa discovery is in a major class and is probably a forerunner of several large fields that will produce from the Glen Rose oölitic and sandy limestones of Upper Trinity in Louisiana, Arkansas and Texas, but the stability of this production and the recoveries per acre are not considered too favorably, past experience suggesting erratic performance.

Six major oil stocks in relation to 50 industrial stocks on the New York Stock Exchange.


1932
1933
1934
1935
J F M A M J J A S O N D
Dollars per Share
N.Y. Exchange average of 50 industrial and railroad stocks (N.Y. Times)
N.Y. Exchange average of six Major Oil Stocks: S.O.N.J., S.O.Ca., S.O.Ind., Texas Co., Socony-Vacuum and Consolidated (Sinclair)

Fitts—Southeastern Oklahoma

THE VALUE of the Fitts pool was very considerably enhanced with the completion of E. H. Moore's No. 3 Atkins in section 32, T. 2 N., R. 7 E., in the lower Simpson section, the Burgen sand, for around 800 bbl. per hour from 4,475 ft. No. 3 Moore was the first well to penetrate the Burgen section of Simpson series.

The extended wildcat play in southeastern Oklahoma, which was caused by the Fitts discovery, will very largely depend upon three test wells now drilling in the area on structures proved by surface outcrops and by geophysical work. It appears that the results will depend upon the age of folding, and if these structures prove to be of pressure type off the mountains they may not have sufficient closures developed during the Ordovician time for commercial accumulations.

Carter Oil Company (S.O.N.J.) et al. No. 1 Thompson in section 34, T. 2 N., R. 9 E., some 14 miles due east from Fitts, on the very pronounced Centrahoma structure, is now drilling at around 5,000 ft. and correlating very high structurally. The chances of production from the Simpson series in No. 1 Thompson are, however, indefinite, as indicated above.

Amerada Petroleum Corporation and others No. 1 Travelers Insurance in section 28, T. 1 S., R. 9 E., 12 miles due southeast from Fitts, was apparently a failure in Simpson series after testing salt water to 5,416 ft.

Continental Oil Company's No. 1 McCarthy in section 12, T. 1 N., R. 7 E., about four miles southeast from Fitts, was drilling at this writing at 3,000 ft. and correlating satisfactorily.

BASIL B. ZAVOICO

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry.

Dr. O. W. Wilcox

Petroleum Geology

Formation Volume and Viscosity Studies.—B. H. Sage, in OIL WEEKLY, vol. 77 (1935), No. 10, pp. 29–32.

Knowledge of the volume occupied by oil and gas in the sands of producing oil pools has a number of possible applications to major problems of oil production engineering, such as estimation of reserves and proration of production from different properties of the same field. By "formation volume" is meant the volume in cubic feet occupied by one cubic foot of oil as measured at the surface temperature (60° F.) and atmospheric pressure. To ascertain this figure it is necessary to take account of the gas-oil ratio and saturation pressure at different temperatures. The paper shows how such data are used to estimate the formation volume. The work was done in the Dominguez field, Calif., as a part of A.P.I. research project No. 37.

Selective Wetting of Reservoir Rock and Its Relation to Oil Production.—Allen P. Garrison, before Am. Petrol. Inst., Tulsa meeting (1935).

Recent investigations in the field of colloid chemistry have made it possible to state, with some certainty, the magnitude of the interfacial or film forces acting within the capillary spaces of reservoir rock. A review of the literature leading to this information is presented. The effect of these interfacial forces on the distribution of oil and water in porous material is shown. Phases of the problem bearing on current ideas of production economy and effective recovery are discussed. It is concluded that oil and water cannot separate completely into layers in the reservoir, but must set up a definite equilibrium in which water fills all the pores having sizes below a certain magnitude. This critical size depends on chemical nature, on elevation, and on the physical constants of the oil and water. In order that a well shall produce nothing but oil, it is necessary that the oil flow to the well bore through the larger pores, at such a rate that it does not cause the water to advance from its equilibrium position in the smaller capillaries to a point where it is forced along with the oil. It is shown that the advancing position of the water into the larger capillaries and, thus, into a position where it is more likely to be transported along with the oil, is dependent on: the interfacial tension of the oil-water contact, the wettability of the reservoir materials by water and oil, the relative densities of the liquids, the elevation, as well as the shape and dimensions of the pores. It is shown that a high rate of production causes the water to move from its static equilibrium position to a new position where larger pores formerly occupied by oil are filled with water. This conception of water as a network of capillaries in equilibrium with the oil throughout the reservoir, is contrasted with that of definite levels of oil-water contact connoted in the terms, "edge water," "coning," or "nosing" of water.

Subsurface Stratigraphy of Northwestern Pennsylvania.—Charles R. Fettke, in Bull. No. 114, Dept. of Internal Affairs (Pa.), 1935.

Recent discoveries of relatively large volumes of gas in the Oriskany sandstone in North Central Pennsylvania has created a very live interest in this field. This Bulletin presents stratigraphic information obtained from several years' study of drill cuttings, particularly as regards horizons below the Upper Devonian.

Foraminiferal Zonation of the Caliborne Formation.—Merle C. Israelsky, in BULL. AM. SOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 5, pp. 689–695.

A tentative foraminiferal zonation is offered for the subsurface Caliborne of Texas and Louisiana, and an attempt is made to demonstrate the desirability of using fossil zones rather than formations in long-distance correlation.

Geology of Venezuelan Andes.—Rolf Engleman, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 6, pp. 769–792.

The Venezuelan Andes, considered as a geologic unit, has a special interest structurally as the abrupt and massive bulwark between the Maracaibo basin and the Orinoco plains, from the lowlands of which, at 100 and 200 meters, respectively, it rises to the maximum of more than 5,000 meters on the snow-capped peaks. Though the bulk of the mountain mass is composed of Paleozoic or older metamorphic rocks, including some fossiliferous Carboniferous, sediments ranging up to Cretaceous are found at 3,000 meters, 4,000 meters, or even higher, and Eocene rocks occupy large areas in the southwestern portion. Topography, a real geology, and structure sections are shown on maps, and serve to indicate broad lines of structure. It is a great geanticline without boundary faults at the present mountain fronts, cut by cross faults which further work may show to be of greater, rather than of less, importance. Present evidence indicates that classic Alpine structural concepts are not applicable to the isolated problem of the Venezuelan Andes. Carboniferous localities not heretofore published are mentioned and further discoveries predicted.

Drilling

Drilling Barges.—C. I. McBride, in OIL WEEKLY, vol. 77, No. 7, pp. 19–26.

In its operations along the Louisiana Gulf Coast the Texas Company expects to effect a saving of $600,000 in 1935 from the use of a fleet of seven drilling barges. The present type is a twin-hull barge which is towed out in the water and sunk where a well is to be drilled, thus providing a foundation on which the derrick and other well appurtenances can be erected. Experience has shown that the foundations thus provided are very stable, and that the 136-foot derricks remain truly vertical during all drilling operations; they have not yielded a fraction of an inch to a severe hurricane. When the well is finished the barge is floated again and towed to the next location. The operations have been surprisingly easy and the longest time required to change locations was 36 hours. A twin barge 114 x 56 x 10 with a 11 ft. superstructure costs about $27,000, a boiler barge about $9,000. The savings, in comparison with permanent piling or concrete foundations, as ordinarily used in marine drilling, relate to saving in cost of piling, exemption from teredo damage and cost of lumber, not to mention the great convenience of being able to move from well to well without dismantling any equipment; all these and other items have combined to reduce drilling costs about $14,251.47 per well, not including certain savings and profits that cannot be easily expressed in dollars and cents.

Truck-Mounted Portable Rotary Unit.—J. A. Niles, before Am. Soc. Testing Materials, Tulsa meeting, 1935.

It was not so long ago that an oil operator's chief object was to drill the largest possible diameter hole in the shortest possible time, to the producing formation, and to produce from the completed well the greatest possible amount of oil per day. During the past few years, proration in oil fields has made these aims both unnecessary and undesirable for the operator. In many fields the amount of oil to be taken from a well is determined by its ability to flow through tubing, thereby making a large diameter hole both unnecessary and costly.

Recognizing the change in drilling requirements, Stanolind Oil & Gas Co., through its

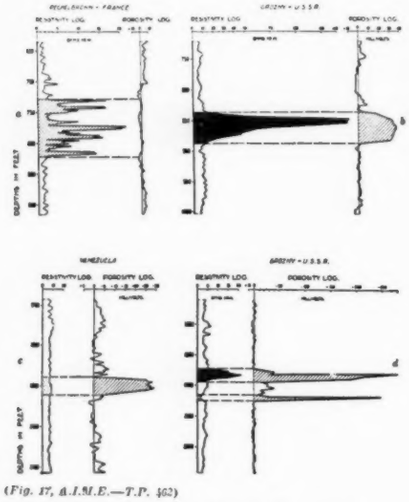
research and development engineers, with the cooperation of the Franks Manufacturing Co., has had designed and built, a portable, truck-mounted rotary drilling unit, for the completion of wells with 6-inch casing up to a depth of 4,000 feet. The test period of this equipment has proven that, within its size and depth limits, it is able to make holes as fast as much bulkier equipment. Moving and rigging up time has been reduced to a minimum, as low as but 20 per cent of the time ordinarily required. It is expected that it will also prove very efficient in deepening and rotary cleanout work.

The outfit weighs 42,000 lbs., so that it is usually necessary to obtain a special permit for travel on the highways.

ELECTRICAL EXPLORATION OF DRILL HOLES.—Alexander Deussen and E. G. Leonardon, before Am. Petrol. Inst., Tulsa meeting, 1935.

Electrical exploration of drill holes is sometimes referred to as "electrical coring"; this expression is often confusing, and should be replaced by "electrical survey" or "electrical log". An electrical survey of a drilled hole is expected to differentiate the different geological formations as follows:

1. Shales, clays, marls are homogeneous and impervious. They generally show a low resistivity and no porosity.



(*Fig. 17, A.I.M.E.—T.P. 462*)

a. Impervious and resistant formation, gypsum (Pechelbronn).
b. Pervious and resistant formation, oil sand (Grozny).
c. Pervious and conductive formation, water sand (Venezuela).
d. Pervious formation resistant at top, oil; conductive at bottom, salt water (Grozny).

2. Hard formations, like gypsum or compact lime, have very high resistivity and no porosity.

3. An intermediate example between (1) and (2) is the porous lime, which possesses a high resistivity but a fairly good porosity.

4. Water sands which in the oil fields are very often salty. They have a low resistivity (sometimes smaller than that of group (1), but show very good porosity with negative potentials.

5. Oil or gas sands carrying insulating fluid have a high resistivity and a good porosity with negative potentials.

The accompanying figure illustrates these different points with actual field results.

WORLD'S DEEPEST TEST.—B. G. Martin and B. Mills, in OIL WEEKLY, vol. 77 (1935), No. 3, pp. 33–36.

A somewhat detailed account is given of drilling operations in connection with the Gulf Production Company's deep well, the J. T. McElroy 103 in West Texas. This well, which was for exploring purposes, reached the record depth of 12,786 feet, which exceeds the previous record by 1,409 feet. A casing string was set at 10,301 feet, also a record. Much valuable engineering and geological information was obtained.

Oil Well Operation

WELL FLOW MEASURED BY METERS.—B. Mills, in OIL WEEKLY, vol. 77 (1935), No. 10, pp. 15–18.

Measuring oil by meters from all types of flowing wells has become a common practice in the Kettleman Hills field. Daily production as shown by individual and group well meters ordinarily checks with storage tank gauges within a negligible range of error. Heretofore attempts to meter flowing wells have not been successful, due to the surging action of the flow, excess gas and error caused by gas held in solution. The practice is to pass the flow through a trap to remove as much of the free gas as possible before reaching the meter. As more gas is held in solution under high than under low pressure, there would still be a large range of error, but this is taken care of by correction coefficients. Corrections are made for temperature, but no correction is necessary for viscosity. The maximum rate of flow is limited chiefly by capacity of the gas trap. Water is metered and prorated back to the wells. The Kettleman North Dome Association has 30 wells on meters and the Standard Oil Co. of California also is using meters there. Two pumpers are able to handle 24 wells on meters.

CENTRAL PNEUMATIC PUMPING PLANTS.—Paul D. Cornelius, before Am. Soc. Testing Materials, Tulsa meeting, 1935.

The pneumatic pumping system is an improved method of actuating sucker rod pumps by the direct application of the energy of a compressible fluid to the polished rod, through the medium of a specially designed cylinder suspended above the well and directly connected to the upper end of the rod string. The complete system consists of a single stage air compressor as the source of power with its driving unit, pipe lines for conducting the compressed fluid to and from the well, preheaters at the wells, and control valves for maintaining the proper operating pressures.

The application of the pneumatic pumping head to producing wells provides certain inherent features of particular importance in reducing operating expense. Its extreme flexibility permits operating at the correct speed for maximum economy and provides ability to meet changing well conditions with power requirements proportional to the duty. The minimum of original investment is required by virtue of the ease with which capacity can be changed. Compressor load is determined by total of all wells in the system and is not affected by individual well change. Salvage value of the equipment is high, as from 50 to 80 percent consists of compressor, pipe and fittings which have wide application in the industry. The pumping head is long lived and is applicable to a wide range of well conditions.

OPERATION OF HIGH PRESSURE GAS WELLS BY MEANS OF BOTTOM HOLE CHOKES.—H. C. Otis, before Am. Gas Assoc., Nat. Gas Dept., Memphis, May, 1935.

The use of removable bottom hole chokes as a means of controlling deliveries at low rates from high pressure gas wells, has, during the past year, become generally accepted throughout the Mid-Continent and Gulf Coast fields. Experience in virtually every high pressure field within these areas has demonstrated not only the entire practicability of this method of well operation wherever there is any tendency towards freezing at the well controls, but also certain very distinct advantages it affords over the older methods of well operation. Both initial investment in control equipment and subsequent operating costs are reduced to a minimum. Any investment in surface heaters, in brine pots, in expensive regulator and surface choke batteries, etc., is eliminated.

The turning of the highest pressure wells into the line is a matter which can be quickly and easily accomplished by one man only. Once on the line the well can be forgotten about, for variations in line pressure and in surface temperatures cannot affect its operation. The worst blizzard of the year will not vary the delivery temperature of the production. There is no fear nor worry that the source of heat which prevents freezing at the choke will prove inadequate at the time gas is needed most, for the source of heat used in this method of well operation does not vary.

This interesting paper details several important phases of the use of bottom hole chokes, including the elimination of slugs and improvement in the fluid raising capacity of gas syphons in low pressure wells.

TECHNIQUE OF SECURING AND EXAMINING SUB-SURFACE SAMPLES OF OIL AND GAS.—Ralph J. Schilthuis, before Am. Petrol. Inst., Tulsa meeting (1935).

In the process of production, oil and gas undergo change in volume as well as changes in the state of the material. If the problems involved in the process are to be understood, it is necessary that information be had concerning both the physical and energy transformations occurring with changing pressures and temperatures.

The laws for perfect gases and solutions are inadequate to express the behavior of oil and gas under high pressure. At the present time insufficient fundamental data are available to permit prediction, with certainty, of the physical changes which complex hydrocarbon mixtures undergo in high-pressure oil and gas reservoirs. In spite of the lack of fundamental data, it seems that one approach to the problem is through the examination of samples

of the oil and/or gas secured in as near their original condition as possible. Apparatus designed to obtain such samples from within wells, and to examine them in the laboratory, is described. The technique involved in the examination and the type of data which may be obtained are discussed.

FOAM PROTECTION SYSTEM FOR TANK FARM.—Frank H. Love, in PETR. ENG., vol. 6 (1935), No. 10, pp. 19–21.

The author describes the fire-fighting layout at a tank farm in Kansas. The system is based on the "two powder system," in which the two foam-producing chemicals are dissolved separately at a central pumping station and separately piped to the various risks, where they are united in foam hydrants. The system is distinguished for rapidity of action and economy of installation.

QUALITY OF FLOODING WATER.—Arthur Simmons, before 5th Penn. Petrol. and Gas Conf., Pa. State College, 1935.

In the Bradford field, where water conditioning of the producing sand is being carried out on a large scale, quality of the water used for flooding purposes has assumed much importance. It is found essential that the water be as free as possible from suspended matter, whether organic or inorganic, that would tend to plug the pores of the sand in the vicinity of the intake well. These pores are of capillary dimensions and a relatively small quantity of precipitated iron or colloidal material will be sufficient to render the sand impermeable. It is a fact that municipal water supplies in the district, though unobjectionable for domestic use, are much too dirty for use in oil recovery and require to be treated. This treatment may consist, according to circumstances, of de-aeration, chemical treatment, and careful filtration. De-aeration may be necessary to prevent excessive corrosion of the piping, which produces iron rust that will block the sand-capillaries; chemical treatment may be necessary to obviate slimy organic growths. Filtration, where necessary, should be efficiently done.

DETERMINATION OF MONTHLY GASOLINE-PRODUCTION ALLOWABLES.—Fred Van Covern, Planning and Coordination Committee, Washington.

This paper outlines the administrative methods for control of the production of refinery gasoline as required by the revised Article IV of the Code of Fair Competition for the Petroleum Industry. The procedures used in making forecasts of demand, setting allowables, determining district demand, shipping stock allowables, seasonal requirements, the work of the National Gasoline Inventory Committee, etc., are outlined at some length.

FLOW LINE TREATMENT OF EMULSIONS.—C. H. M. Roberts, in PETR. ENG., vol. 6 (1935), No. 10, pp. 43–48.

"Flow line treatment" is a term applied to a system for electrical resolution of crude petroleum emulsions by the Petreco process, wherein the emulsified oil is conducted directly and continuously from the producing well to the dehydrator, from which it is delivered directly to dry oil stock. The advantage of this sytem is that the emulsion is attacked at the earliest possible stage, before it reaches a condition of maturity or stability in which it is most resistant; the emulsion is thus given little opportunity to "age", which is one of the disadvantages of the batch system. The latest improvements of the system are described.

Natural Gas

RAPID DETERMINATION OF "PENTANES PLUS."—R. N. Donaldson, in PETROLEUM WORLD, vol. 32, No. 3, pp. 27–34.

An important object in the operation of a natural gasoline plant is to reduce to a minimum the losses of valuable gasoline fractions in residue gas. Up to the present there has been lacking a testing method by which the pentane-plus fractions in residue gas could be determined, particularly one that will respond quickly and dependably to changes in plant operating conditions where the gas has to be dried to a gasoline content of the order of 0.01 G/M. The method developed by the author consists of passing a sufficient volume of the gas to be tested through a special butane solvent that is maintained at the temperature of liquified propane or lower. The resulting solution of butane, containing fractions higher than pentanes, is then "weathered" to a specified temperature. The residue remaining at this temperature is read and interpreted in terms of pentanes-plus by means of a standard weathering curve. The accuracy of the test has been amply substantiated; in comparison with former methods there is great saving of time and expense.

Pipe Lines

WIND GENERATOR FOR CATHODIC PROTECTION.—Anon. PIPE LINE NEWS, vol. 7 (1935), No. 7, p. 8.

The Texas Pipe Line Company has proved the feasibility of using windmills to generate the electric current required for cathodic protection of its Dayton-Port Arthur line. A wind-driven generator of special design supplies current of from 10 to 100 amperes per hour; the generator is driven by a two-blade propeller which will start with a wind velocity of 9 miles per hour but will keep running until the wind drops to 3 or 4 miles per hour. Sufficient power was generated by the first installation to be felt 12 miles along the line and full protection is believed provided for five miles. During the test period it was found that the pipe line contained enough potential to combat corrosion for 17 hours after the generator had been shut down; since 17 hours of insufficient wind is unusual in most localities it is fairly conclusive that the pipe will remain negative to the ground at all times. The possible savings to pipe line companies are considered to be enormous.

DEVELOPMENTS AND IMPROVEMENTS IN GAS TRANSMISSION.—E. R. Duree, before Am. Gas Assoc., Nat. Gas Dept., Memphis, May, 1935.

This paper reviews some of the more important changes which have taken place in the construction and operation of gas transmission lines.

From the building of a double 8 in. line into Chicago from Greenstown, Indiana, a distance of 120 miles, in 1891 to the construction, within the past four or five years, of 22, 24 and 26 in. lines distances up to 1,000 miles or more from the source of supply, there has been considerable development and improvement. The principal items of progress are specified as:

The development of tight pipe joints that will hold for a long term of years without leakage or interruption occurring and

The development of high carbon, thin walled steel pipe with high tensile strength plus

The development of mechanical equipment rendering the labor cost economical to construct lines of long distance and

The development of gas engines to high efficiency for the recompression of gas.

In view of the present large diameter of long distance pipe lines in successful operation, one does not have to strain the imagination to visualize even longer and bigger lines than those at present, if sufficient quantities of natural gas reserves continue to be available in the future to justify the construction of these gigantic projects.

Petroleum Refining

CLARK VAPOR PHASE PLANT IN OPERATION.—Reed W. Garman in PETROLEUM WORLD, vol. 32 (1935), No. 3, pp. 38–45.

The special feature of the Clark process is the burning of fuel under pressure in a chamber with no heat removal devices, so that the combustion gases may be mixed directly with vaporized gas-oil to heat it to cracking temperature. The efficiency of the unit operated by the Rice Ranch Oil Co. at Orcutt, Calif., is remarkable. The product is of excellent quality and has a high octane value. The installation is described.

SOLUBILITY OF MINERAL OIL AND TAR CONSTITUENTS IN LIQUID HYDROGEN SULPHIDE.—E. Terres and W. Vollmer, in PETROLEUM, vol. 31 (1935), No. 19, pp. 1–12.

Experiment showed that the solubility of benzol, toluol, phenol o-cresol, naphthaline, beta-methynaphthylene, anthracene, phenanthrene, octadecane, hexahydrobenzol and quinoline, is to be considered good, offering possibilities of using liquid hydrogen sulphide as a selective solvent.

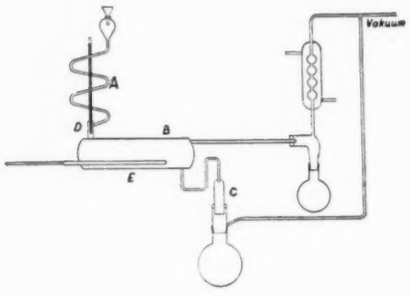
PERFORMANCE AND FLEXIBILITY OF THE DUO-SOL PROCESS.—Malcolm H. Tuttle, before Am. Petrol. Inst., Tulsa meeting (1935).

In the refining of lubricating oil it is shown that conventional methods lack flexibility, and are limited as to quality and yield of product. Some improvement is obtained by counter-

flow treatment with naphthenic solvents, but this method is limited by characteristics of raw stock in their effect on quality and yield of finished oil. The Duo-Sol process, by counterflow use of propane and naphthenic solvent, introduces a new principle of extraction which permits operation on any lubricating-oil stock, regardless of source, to produce oils of highest quality, both as to viscosity index and also as regards stability. Stability of Duo-Sol oils is compared, by the Indiana oxidation method and by engine tests, with that of solvent-treated and conventionally-refined oils. The article is illustrated by photographs of engine parts after test runs.

Laboratory Still for Continuous Film Evaporation of Mineral Oils.—C. Walther, in OEL UND KOHLE, vol. 11 (1935), No. 19, pp. 324–326.

In the continuous film evaporator illustrated in the accompanying sketch the raw oil is passed through a preheating coil A, into a



long nearly horizontal tube still B, on the sloping bottom of which has been placed a thin-meshed wire gauze; the temperature of the entering oil is measured at D, and the temperature of the vapor in B is measured by a thermometer inserted in a projecting tube E; distillate and residue are received in separate vessels connected with the same vacuum line.

This film evaporator has been found especially useful in obtaining sharp separations of lubricating oil fractions. The distilling vessel B may be made of copper and electrically heated by a sufficient number of turns of chrom-nickel wire.

Petroleum Chemistry

Photochemical Formation of Color, Haze, and Reaction Products in Hydrocarbons.—J. C. Morrell, W. L. Benedict, and Gustav Egloff, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Pure hydrocarbons exposed to the carbon arc light in oxygen developed peroxides, acids, and aldehydes. Color and haze formed only in the presence of sulfur or n-propyldisulfide. In nitrogen or hydrogen, reaction of sulfur with saturated hydrocarbons occurred, resulting in color formation and evolution of hydrogen sulfide. Unsaturated hydrocarbons similarly exposed formed color, hydrogen sulfide, and mercaptans. n-Propyldisulfide reacted with the hydrocarbons in nitrogen or hydrogen to form mercaptans, but caused color formation only in 2, 2, 4-trimethylpentane and cyclohexane. The changes observed affected only a small proportion of the hydrocarbons since no change in bromine number or refractive index occurred. The results were similar to those obtained with gasolines.

Quantitative Detector of Hydrogen Sulphide Gas in Air.—J. B. Littlefield, W. P. Yant and L. B. Berger, in Bureau Mines Rpt. of Investigations No. 3276 (1935).

The need of suitable field apparatus for detecting minute amounts of hydrogen sulphide is apparent from the wide industrial occurrence of this gas and its physiological reactivity, confirmed by the many cases of poisoning which have occurred. Since most of the exposures occur in industry, particularly in the production and refining of high-sulphur petroleum, and in what must be termed the field, a suitable apparatus and procedure must be capable of being operated by workmen, must be rapid in giving results, and must be accurate enough to indicate, at least semiquantitatively, concentrations which range from those which are harmless or but slightly harmful to those immediately dangerous to life.

The apparatus designed for this purpose by the authors consists of a small-bore glass tube filled with granules of activated alumina ("hydralo") on which has been deposited a coating of silver cyanide; the tube is connected with a small hand air-pump or squeezing-bulb, a few strokes of which will draw a certain volume of air through the tube from below upward. The silver cyanide will be turned black by hydrogen sulphide, and the height of this zone of discoloration will indicate the quantity of the gas in the atmosphere.

The poisonous action of hydrogen sulphide begins when the air contains 0.005 to 0.01 per cent, and becomes lethal at above 0.07 per cent by volume.

The Chemical Properties of Petroleum Oil Unsaturates Causing Injury to Foliage.—R. P. Tucker, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Experimental evidence indicates that the unsaturated hydrocarbons of the lubricating fractions of petroleum oils are not toxic to foliage until they are oxidized to asphaltogenic acids. At ordinary temperatures this oxidization takes place to a measurable degree only in the presence of air and light. Using apricot leaves as a testing medium, it has been found that the toxic threshold is reached when approximately 0.7 per cent of asphaltogenic acids are formed. The relation of viscosity and percentage of unsaturates present in a spray oil to its susceptibility to oxidization in light of various intensities is discussed.

Mechanism of Gum Formation in Cracked Gasoline. II. Composition of Gum.—J. C. Morrell, C. G. Dryer, C. D. Lowry, Jr., and Gustav Egloff, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Cracked gasoline from Pennsylvania, West Texas, and California stocks was allowed to become oxidized, both by subjecting to oxidation at elevated temperature and by storing in contact with air. Each sample was then distilled into two overhead cuts and a gum residue and analysis made of each fraction, including determination of peroxide, aldehyde, and acid. The oxidation products, particularly the peroxides, tended to concentrate in the residue, though they were also present in considerable amount in the overhead cuts. Study was also made of the formation of peroxide, aldehyde, and acid during the determination of gum by copper and glass dish and elementary analysis of gum was made. The results support the conclusion earlier drawn that peroxides are primarily concerned in the gum-forming process but do not preclude aldehydes and acids taking part in the process.

A Modification of the A. S. T. M. Lamp Method for the Determination of Sulfur.—V. Zahn, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

A modification of the A. S. T. M. lamp method has been devised suitable for use with purified air. The air flow is divided into two independently regulatable streams, the primary being fed to the lamp, the secondary into an annular space between two skirts of a chimney. This arrangement insures an evenly burning flame, and importance for accuracy is demonstrated.

Combination of the arrangement described above with a nephelometric determination of the sulfuric acid formed leads to an accuracy, estimated to be within ± 0.0001 percent, limited by the accuracy of a rather crude nephelometric comparison, which could be substantially improved.

Syntheses from Natural Gas Hydrocarbons. IV. Nitration of Gaseous Paraffins.—H. B. Hass, E. B. Hodge, and B. M. Vanderbilt, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Nitromethane, nitroethane, both nitropropanes, and all four nitrobutanes have been made for the first time by direct nitration of hydrocarbons. Operation is in vapor phase. Ratios of isomers in the reaction products are controllable to a considerable extent. These compounds are colorless, relatively non-toxic, stable solvents boiling from 101° to 151° C. Their physical and chemical properties, possible uses in Diesel fuels, in pyroxylin solvents, in the solvent extraction of lubricants and the economics of their production are discussed. They are readily converted to aminos, nitro-alcohols, amino-alcohols, nitro-olefins, ketones, aldehydes, or fatty acids.

Potentiometric Determination of Mercaptans.—M. W. Tamele and L. B. Ryland, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

A new procedure is described for the quantitative determination of mercaptans based on the precipitation with silver nitrate. The titration is performed in an alcoholic solution of sodium acetate, using enough alcohol to dissolve the hydrocarbon sample, and titrating with a solution of silver nitrate in isopropyl alcohol. The end point is determined potentiometrically, using a silver electrode as an indicator, thus avoiding an excess of silver nitrate and eliminating the danger of simultaneously precipitating impurities. The method is applicable to colored solutions, as the selec-

tion of the end point is not dependent on a color change of an indicator.

Pressure Pyrolysis of Paraffin Hydrocarbon Gases.—Hans Tropsch, C. L. Thomas, and Gustav Egloff, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Propane, n-butane, isobutane, and mixtures containing these gases have been pyrolyzed at 525–575° and at 725 lbs. per sq. in. pressure. The gases produced contained paraffin hydrocarbons of lower molecular weight than the hydrocarbon charged, along with ethylene, propane, and butanes. At a sufficiently long contact time a part of the olefins were pyrolyzed to liquid products. By catalytically polymerizing the produced olefin liquids, it is estimated that 1000 cu. ft. of butanes would give 10 gal. of liquid product, 90 percent of which is gasoline having an octane number of 77 or a blending value of 93 octane by the C. F. R. motor method.

Petroleum Physics

High Temperature Viscosities of Liquid Petroleum Fractions.—K. M. Watson, Jerome L. Wien, and George B. Murphy, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

The capillary tube method was used to determine the kinematic viscosity between 100° and 800° F. of a series of liquid hydrocarbons ranging from pure benzene and normal heptane to lubricating oils and products from commercial cracking units. The data can be satisfactorily expressed by the equation log (log $\mu/s + 1.7) = a(t + 100) + b$ for temperatures above 210° F. On the basis of this equation a high-temperature viscosity chart was developed. A nomograph was developed permitting the estimation of the viscosity temperature curve of a liquid from laboratory inspection data. Pressures up to 500 pounds per square inch had little effect on the kinematic viscosity in the range of the determinations.

Structure of Lubricating Greases.—Bruce B. Farrington, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

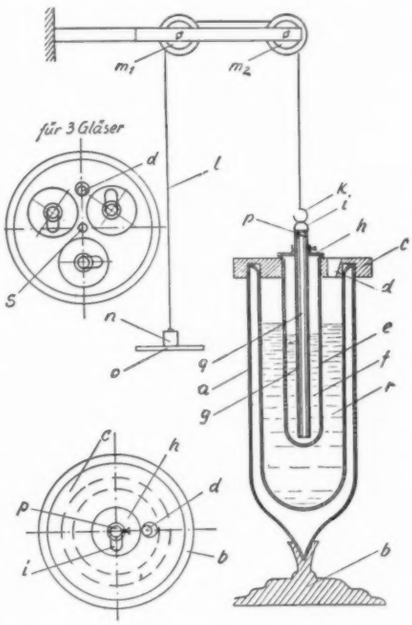
A method for obtaining photomicrographs of lubricating greases is presented and briefly explained. The pictures obtained clearly show the differences in length of soap fiber in different types of grease. The soap fibers vary in length from 1 mm. to a fraction of a micron. The texture of lubricating greases is correlated with the length of soap fiber. A system of classifying lubricating greases by means of soap fiber length is proposed, and an application of the microscopic method to practical grease manufacture is discussed.

Laboratory Service Testing of Automotive Lubricating Greases.—E. N. Klemgard, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Distinctions between chemical laboratory analyses, physical laboratory tests, laboratory service tests, and road tests are discussed. Laboratory service tests are valuable for speed, economy, and precision, but road tests are necessary for final evaluation of service properties. Detailed procedures for determining serviceability of five different classes of chassis lubricants are given. Devices for making service tests on wheel-bearing greases are detailed. A laboratory service test incorporating a worm and roller steering gear equipped with anti-friction bearings and a worm and sector gear with plain bearings is discussed, and the study of eight lubricants tabulated. A device for the study of water pump grease in the presence of boiling water is described. Specifications for various lubricants are discussed.

Behavior of Automobile Lubricating Oils in the Cold.—A. Baader, in Oel und Kohle, vol. 11 (1935), No. 27, pp. 471–474.

Heretofore there has been lacking a method for testing lubricating oils at extremely low temperatures. This lack has been supplied by development of the apparatus shown in the accompanying illustration. A Dewar vessel *a*



is provided with a cover *c* with an opening for a test tube *e* having a cover *h* in which is an opening in which to hang a copper tube *g;* this tube is attached by a string that passes over rollers M_1 and M_2 and is tied to a weight *n* that rests on a support *o*. In operation, the test tube is filled with the oil, the copper tube is inserted, and the temperature of the oil is gradually lowered by periodical additions of solid carbon dioxide to the Dewar vessel; when the temperature of the oil has reached −35° C (−31° F) this temperature is maintained for 30 minutes. (The temperature is measured by a thermometer suspended in absolute alcohol, with which the Dewar vessel is partly filled). Then the support *o* is removed from under the weight *n* and the time required to pull the tube *g* out of the oil is noted by a stop watch. To avoid a vacuum under the lower end of *g*, this tube at first contains a rod *p* which is removed at the start of the test. This procedure gives a figure representing the viscosity of the oil below the pour point, a property which cannot be predicted from the viscosity curve of the fluid oil.

Design of Fractionating Columns. III. Number of Plates for Petroleum Columns.—Sidney Charles Singer, Jr., Roy Russell Wilson, and George Granger Brown, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

A satisfactory procedure for graphical determination of the number of equilibrium plates and required refluxes for separation of complex mixtures has been developed from the use of equilibrium curves such as described by Obryadchikov and Katz and Brown, and McCabe and Thiele's graphical method for binary mixtures. Over-all plant efficiency in modern petroleum practice is close to 100 percent on gasoline and naphtha. In the case of higher boiling fractions it is considerably lower. The graphical method is satisfactory for computing the number of plates if requirements are no more than 6 to 8 plates. The empirical equilibrium curve of Katz and Brown may be used for less accurate work.

Uses of Petroleum

Progress in the Field of Lubrication, 1934.—A. van der Werth, in Mineralole, vol. 8 (1935), No. 3, pp. 121–127.

This is a review of notable American, German, French and other patents that appeared in 1934 in relation to lubricants and lubrication. The patents considered are divided into seven groups: special treatment of mineral lubricating oils, hydrogenation, polymerization, additions to mineral lubricants; regeneration of used oil, non-mineral oil lubricants, and miscellaneous. Each invention is briefly described.

Industrial Utilization of Propane and Butane.—W. Z. Friend, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

Bureau of Mines Report M.M.S. 375 shows a 23.7 percent increase in marketed production of liquefied petroleum gases in 1934 over 1933 and a 73.0 percent increase in volume of these fuels used for industrial purposes during the same period. A summary is given in outline form of the principal industrial applications and processes to which propane and butane have been applied other than applications as chemical raw material. Industrial applications described include heat treatment of ferrous and non-ferrous metals; metal melting; baking, fruit ripening, and other uses in food industries; glass melting and annealing and other uses in ceramic industry; oxypropane cutting of iron and steel; air heating and conditioning; textile plant applications; use as internal combustion engine fuel; railroad applications; use as refrigerants; use as solvents. A number of properties of propane and butane are discussed with especial reference to their significance in industrial applications. Diagram of typical industrial plant storage,

vaporizing, and regulation equipment is shown. Economics of supply and price are discussed. Attention is called to the possibility of wide variety of applications in the same plant using the same propane first as solvent, then as refrigerant, and finally as fuel. Example is given of possible use in the operation of cold storage or ice manufacturing plants through vaporization of propane, then the use of the gas as a domestic cooking and heating service and as a fuel for gas engine-generator sets furnishing electrical supply.

SERVICE CHARACTERISTICS OF MOTOR OILS AS RELATED TO COMPOSITION.—David R. Merrill, C. C. Moore, Jr., and Ulric B. Bray, before Am. Petrol. Inst., Tulsa meeting (1935).

By means of solvent fractionation, it has been possible to separate lubricating oil into typical classes of components characterized by different physical and chemical properties. The performance characteristics of these components have been studied with particular attention to:

1. Wear.
2. Sludge formation and other results of crankcase oxidation.
3. Carbon deposition as affecting the octane requirement of the engine.

The rate of wear has been found to be a function of the paraffinicity of the lubricating oil, with the low-API-gravity, high-VGC components showing many times the wear of the highly paraffinic fractions. No difference was found between the wear characteristics of highly paraffinic oils of wide and narrow boiling range. Oxidation stability, reflected in service in reduced formation of sludge and acidity and less viscosity change, was found to be greatly improved by thorough removal of the components of low gravity and high viscosity-gravity constant.

The change in octane requirement, due to carbon deposition in service, has been compared for typical residual Pennsylvania oils and a highly solvent-treated oil of restricted boiling range. The average rate of carbon formation with the Pennsylvania oils was equivalent to an increase in octane requirement of one octane number for each 300 to 400 miles driven, until the increase was about 7 to 14 octane numbers—beyond which point little further change seemed to occur. With the solvent-treated oil of narrow boiling range, the increase was only about one point for each 1,000 miles—until an increase of 2 to 4 points occurred, after which further increase was very slow. From these results, it is concluded that, in order to produce oils giving low wear and sludge formation and also low carbon deposition, it is desirable to remove not only all components of low API gravity, but also the paraffinic components of highest boiling point.

Petroleum Substitutes

LIGNIN AS MOTOR FUEL.—Max Moldenhauer, in CHEM. ZEIT., vol. 59 (1935), No. 35, p. 356.

The author considers that the manufacture of alcohol for motor fuel purposes on a large scale is now only a question of time, especially in countries like Germany that are more or less barren of native petroleum resources and are confronted by exchange difficulties in the financing of imports. In this connection he calls attention to a by-product of the wood-sugar industry that has been heretofore overlooked. This is the residue of lignin that is left after the hydrolysis of woody materials by acids. When 100 kg. of dry pine wood is saccharified and the resulting sugars are fermented there are produced 24 liters of alcohol and 30 kg. of lignin. This lignin is obtained as a dry powder, practically ash-free. This powder can be exploded in an internal combustion engine; the practicability of this use has already been sufficiently demonstrated by the construction of motors operating with powdered stone coal. The difficulty with coal is the ash content, which not only causes excessive abrasion of the cylinders, but gives rise to an exhaust heavily laden with dust; this dust nuisance does not attach to the use of by-product lignin.

The economic implications are summed up as follows: Raising the amount of alcohol required to be mixed with gasoline in Germany to 20 percent would enable the wood-sugar industry to consume a million tons of wood a year; aside from the alcohol produced from this wood there would also be obtained 300,000 tons of lignin. Since two tons of lignin as Diesel fuel are equivalent to one ton of Diesel oil, petroleum imports could be decreased by 150,000 tons.

VEGETABLE OILS AND DIESEL MOTORS.—M. Gautier, in REV. COMBUST. LIQUIDES, vol. 13 (1935), No. 124, pp. 129–136.

As a result of an elaborate series of experimental researches at the French Etablissement National de la Marine at Indret, it is concluded that the problem of the utilization of vegetable oils in Diesel engines has been completely solved. This conclusion holds for Diesel engines of every type, and of all sizes and all speeds, and for either pneumatic or mechanical injection. This being the case, a supply of liquid fuel for power and transportation can be obtained independently of the petroleum industry, the only question being that of price.

As regards the supply, the author notes that aside from rape and olive oils produced in France, the French colonies produce peanut, castor, palm and coconut oils. Leaving out of consideration all these oils except palm oil, and regarding only the territory of the French Ivory Coast, it is calculated that to supply France with all needed liquid fuel it would be necessary to increase the area now in palm oil plantations in that colony to not more than one million hectares (2½ million acres), assuming an average yield of 3 tons per hectare.

It is recognized that the matter has not yet become acute because of the present abundance and cheapness of petroleum supplies. A failure of these supplies, or an inordinate increase in petroleum prices would alter the situation and give the question of vegetable oil fuel real significance. It is figured that by systematically organizing the culture of palm nuts, erection of modern oil extraction mills, provision of adequate transportation and especially a reform of French taxation, which is doing more than anything else to keep down trade in these oils, the present cost of this combustible material could be reduced by more than half with benefit to both the "metropole" and the colony.

PRESENT DAY PROBLEMS IN POWER PRODUCTION.—Hermann Suida, in PETROLEUM ZTSCHR., Supp., vol. 31 (1935), No. 11, pp. 1–8.

As the author views the world's power and fuel problem, with especial reference to automotive traction, the two most prominent facts are that the whole world outside of the United States is greatly undermotorized and that native or indigenous supplies of automotive fuel are very unequally distributed. From the first fact it results that the world demand for motorized vehicles must eventually attain immensely greater proportions, and consequently the use of automotive fuels must also greatly expand; from the second fact it results that densely populated centers of civilization having little or no native supplies of petroleum must, for reasons of internal economy and national security, bend every effort to make themselves as independent of foreign supplies as they possibly can.

Among the materials other than petroleum that might come into consideration and which are generally more available, are compressed coal gas, generator gas from charcoal or wood, and pulverized mineral coal. It is a fact that whether produced from coal, coke, lignite, charcoal or wood, combustible gases other than petroleum gases have small energy values when compared under normal pressure conditions; thus, a cubic meter of natural gas contains 8,500 energy units, a cubic meter of coal gas 4,000 units, and a cubic meter of generator gas (whether from coal or wood) 1,500 units. In order to get satisfactory use from wood generator gas it is necessary to have a high compression rate (1:12); when used in ordinary gasoline engines such gas therefore has a low efficiency. But when the engine has proper dimensions completely satisfactory results are obtained, as shown by tests in mountainous regions of Austria, Italy, Switzerland and Germany. Wood is thus proved to be a good substitute in countries having an excess of wood and no natural petroleum resources.

Petroleum Economics

OIL GROUPS' RESULTS IN 1934.—Oskar Tokayer, in PETR. PRESS SERVICE, vol. 2 (1935), No. 12, pp. 1–3.

Shareholders in the large oil groups have reason to be satisfied with the financial results of 1934. These companies have not only increased their dividend rates above the low figures of the depression years, but the published reports also justify the expectation that the depression has been left behind and that the way is free for a further ascent.

This increased profit has been attained in the face of a number of difficulties. In the latter part of the year a decline in the price of most petroleum derivatives set in, and during the final quarter culminated in a rather fierce price war which absorbed much of the profits earned during the previous upturn. Other unfavorable factors were weakness in the export markets and the tendency toward heavier taxation, which has in certain instances definitely prevented consumption from increasing. The fact that the big companies were able to increase their earnings and their dividend rates in the face of these difficulties is ascribed to the policy of rationalization and economy which

they had already started when the depression set in. This policy has resulted in a higher efficiency in production, refining, transport and distribution, whereby operating costs have been reduced to a level that would have been unbelievable under former conditions. In spite of the unfavorable conditions above mentioned there was an increase in production to meet a larger consumption demand, while expenses did not increase in proportion; this also contributed to a lowering of costs per unit. The tendency of the companies to effect economies by reducing their long-term indebtedness is also noteworthy.

The improved character of the situation is illustrated by comparison of the dividend rates of five companies in 1929, 1932 (middle of the depression), and 1934:

	1929	1932	1934
Standard Oil (N.J.)	7½	8	5
Socony-Vacuum	6⅖	3	3⅗
Royal Dutch	24	6	7½
Shell	25	7½	12½
Anglo-Persian	20	7½	12½

The 1934 dividend rate is instructive because it illustrates not only the revival of the industry but also the long distance still to be traversed before the 1929 level is reached again.

Should France Create a Synthetic Petroleum Industry?—L. M. Bertrand, in CHIMIE AND INDUSTRIE, vol. 33 (1935), No. 6, pp. 1503–1506.

The Leuna and Ludwigshafen plants in Germany and the Billingham plant in England have demonstrated the technical feasibility of producing petroleum synthetically from coal.

With reference to the agitation in France for laying the foundation of a national synthetic petroleum industry, the author points out that France is not in the same position with regard to supplies of coal as Great Britain and Germany; the French are, in fact, the world's principal importers of coal, and in time of war it will probably be more difficult to import coal than it will be to import petroleum. On the economic side, it is to be taken into consideration that a ton of gasoline from coal costs 1300 francs, whereas it costs only 400 francs to produce a ton of gasoline from natural crude petroleum. This being the case, from the economic standpoint it will be much more practicable for the French to create storage for a three years' supply than it will be to erect a synthetic petroleum industry that would have to operate on imported coal.

Economic Spacing of Oil Wells.—M. G. Cheney in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 6, pp. 876–899.

Economic spacing of oil wells is defined to mean that unless an added well seems likely to yield sufficient *additional net* income to permit a fair margin of profit, its drilling must be considered uneconomic. Both the probable net return from the added well and the fair margin of profit depend on a great number of circumstances which have to be weighed separately and together. After a general discussion of the principal financial, physical, engineering and geological factors, the author indicates the following steps through which a conclusion is reached:

1. Classify the reservoir according to its probable control, namely hydraulic, volumetric, or "capillary," or, in other words, the probable relation of energy available to energy required for high percentage recovery. 2. Estimate the effective drainage area under ideal conditions of wells drilled under this type of control, and conditions which will obtain, such as depth, character of oil and reservoir ("producing permeability"), et cetera; for example, one well per 80, 40, or 20 acres, respectively, for hydraulic, volumetric, or "capillary" control. 3. Estimate to what extent fixed physical factors, such as lenticularity of reservoir or structural conditions, limit or require modification of this maximum spacing. 4. Consider probable effect of the operating practices which will be followed. These will affect many of the factors involved. 5. Consider what adjustment, if any, is needed because of ownership, economics, or proration. 6. Estimate the probable net operating return per acre as a possible factor, either to decrease or increase the normal density of wells. 7. Compare alternative spacing plans as to added costs and additional net returns probable from closer spacing and greater number of wells. 8. Adopt the widest and most flexible spacing plan feasible, with provision for drilling additional wells if needed for high percentage recovery.

Effects of Mexican Oil Policy.—Jose S. Noriega, in WORLD PETROLEUM, vol. 6, (1935), No. 7, pp. 406–411.

The precipitous decline of Mexican oil production, following a phenomenal increase that culminated in the peak of 1921, is ascribed to well intentioned but misguided economic and social experimentation on the part of the Mexican government. The oil policy of this government has been dominated by two leading purposes. The first of these is the desire to curtail and restrict the participation of foreign oil enterprises in the development of the industry and so far as possible to vest title to all petroleum resources in the government; the other is a tendency toward radical and socialistic labor legislation. In addition, there have been created a number of difficulties arising from excessive and inconsistent taxation. The net result has been to deprive foreign capital of incentive to prospect for new production to replace the exhausted fields; the Mexican oil industry is not likely to revive until this incentive is restored.

Books

Petroleum: Twenty-five Years' Retrospect, 1910–35.—Published 1935 by Institution of Petroleum Technologists, London. 219 pages. 7s 6d.

This volume is intended as a celebration both of the 21st anniversary of the founding of the Institution of Petroleum Technologists and the Silver Jubilee of H. M. King George V. The contents take the form of short papers outlining the phenomenal changes that have come over the petroleum industry during the period covered. The subjects that are reviewed include economics of the petroleum industry, oil prospecting methods, petroleum geology, geophysics, drilling, production engineering, distillation, cracking, refining and treating, transportation and storage of oil, ocean transport, storage installations, distribution of petroleum products, chemistry of petroleum, tests of petroleum and their standardization, fuel development for internal combustion engines, natural gas, chemical intermediates and special products from petroleum, asphaltic bitumen and asphalt, the Scottish shale oil industry, and the production of oil from coal. Each of these papers is the product of one or more experts in the field treated.

Handbook of Chemistry.—Compiled and Edited by Norbert Adolph Lange, Ph.D. 1545 pp.; Fabricoid, $6.00. Handbook Publishers, Inc., Sandusky, Ohio. 1934.

The present compilation of Dr. Lange and his collaborators is an outstanding reference volume for all requiring ready access to chemical and physical data used in laboratory work and manufacturing. Its scope is not limited to chemistry, inasmuch as the 1264 features, together with a mathematical appendix of 245 pages, will prove useful to the student, metallurgists, physicists, engineers, mineralogists, and all those requiring comprehensive, authoritative and ready information on the many phases of science.

Many new features not found in other handbooks or previous editions are incorporated. A large table of heat and corrosion data, resisting alloys, physiological response to gases and vapors, an unusually complete table of conversion factors not to be found elsewhere, physical-chemical equations, an index of 2500 listings covering 29 pages, are some of the newly added features.

Natural Gas Handbook.—John C. Diehl. Published by the Metric Metal Works of the American Meter Company, Erie, Pa. Reprinted 1934. 578 pp.

This work is the latest revised edition of Westcott's Handbook as undertaken by the present author. The present reprint is complete, with numerous tables on the properties of gases, their characteristics and measurement, with sufficient introductory matter included to serve as a text.

Field work, from leases and contracts through the drilling of gas wells, and well control are discussed. The characteristics of pipelines, their construction, operation and maintenance and the distribution of gas, and final domestic and industrial consumption are considered with equal detail.

The book is dedicated to the Gas Industry and will no doubt prove as helpful as the former editions.

Chemical-Technical Development in the Field of Hydrocarbon Oils (German: Chemisch-Technische Entwicklung auf dem Gebiete der Kohlenswasserstoffeoele).—Vol. 2, 1928–1932, by Maximilian Pflucke and Carl Walther. Published (1934) by Verlag Chemie, G.m.b.H., Berlin. 695 pp., with 38 figs. Paper 58 RM; bound, 60 RM.

This work is essentially a complete bibliographical survey of research and progress of chemical technology of the petroleum industry in the five years 1928–32. It is intended to carry on a similar undertaking which, under the title "Light Hydrocarbon Oils," by Max Naphtali, has covered the period 1921–27.

The text of the present volume consists of abstracts originally printed in "Chemisches

Zentralblatt," but classified according to subject matter. In this way all publications relating to a particular phase of petroleum chemical technology are brought together for easy reference, thus enabling researchers to make a survey of the literature of that subject with a minimum of effort. A very complete index of patents is given. The work can be highly recommended as a reference book for petroleum technologists who read German.

Treatise on Sedimentation.—William H. Twenhofel and collaborators. Second Edition 1932. 926 pp. The Williams & Wilkins Co., Baltimore, Md. Ill., diagrs., charts, tables. $8.00.

In view of the particular association of petroleum with sedimentary deposits, the present monumental work offers a scholarly presentation that should prove invaluable in obtaining a fundamental appreciation of petroleum geology.

Dr. Twenhofel has had the collaboration of distinguished geologists in the preparation of this second edition. The manuscript for the topic "Carbonaceous Deposits" was prepared by the late Dr. David White. This topic deals with the occurrence of carbonaceous sediments, their source, the environmental conditions of coal deposition, sapropelic bituminous sediments, the alteration products of organic sediments, the mother rocks of petroleum.

The book is divided into eight chapters. The first three study the terrigenous, organic, volcanic, magmatic and cosmic sedimentary sources. The fourth treats of sediments and organisms and the modification of organic matter in territorial seas, and lake bottoms. The author describes the various classifications and concludes that the study of sediments is not sufficiently advanced for the preparation of a detailed classification.

Subsequent chapters treat structures, textures, colors of sediments and their origin. Environments or Realms of Sedimentation and field and laboratory studies of sediments are the concluding topics.

Fire Hazard Properties of Certain Flammable Liquids, Gases and Volatile Solids.—Compiled by Committee on Flammable Liquids of the National Fire Protection Association. Boston, Mass. Revised Edition, 1935.

This compilation lists the available information on the fire hazard characteristics of flammable liquids and other substances giving the flash point, ignition temperature, explosive range, vapor density and underwriters' laboratory classification.

Chemistry and Technology of Cracking.—A. N. Sachanen and M. D. Tilicheyev. 389 pp. $8.00. Translated from the Russian by A. A. Boehtlingk, D. F. Brown and K. T. Steik. Reinhold Publishing Co.

The authors conducted a long series of experiments at the Petroleum Research Institute of the Grozneft, extending over a period of four years, on the chemical and physical laws which govern the reactions occurring when petroleum oil is subjected to cracking conditions. The data obtained in these investigations, together with their interpretations and conclusions are offered in the present work.

Of the nine chapters the first seven are devoted to the chemical nature of cracking and its products, the eighth to a review of the principal cracking processes commercially practiced (primarily descriptions of well known American processes), and the last chapter deals with the hydrogenation of petroleum products.

Contrary to American continuous pilot plant practice, the experiments were carried out in laboratory batch stills of 1 kg. maximum charging capacity consisting of an autoclave, dephlegmator, condenser and receiver. This procedure has its limitations and equilibrium conditions as would occur in continuous operation are necessarily not present.

The investigations on the cracking of petroleum were carried out with Russian oils at 425° C. and from 10 to 40 atmospheres pressure. Three forms of cracking oils are differentiated as first form; viscosity breaking without products; second, gasoline and residuum as primary products; third, gasoline with attendant coke and gas formation as only products. Temperatures of 400° C. are held to be too slow and 450° C. too fast for cracking.

Some of the conclusions advanced are that paraffins decompose into methane and unsaturates. The cracking of aromatics such as benzene, naphthalene, etc., is almost exclusively a condensation reaction. The effects of cracking napthenic hydrocarbons is the dehydrogenation of six-ring molecules to aromatics and condensation of these. The above conclusions were deduced from cracking solid paraffin wax and di-isoamyl as representatives of the paraffins; benzene, cymol, tetralin and anthracene as aromatics; white medicinal vaseline oil as constituting primarily the napthenic hydrocarbons. Other deductions which their experiments bore out were that pressure is of no particular importance on the gasoline yield; the rate of cracking doubles for every 10° C. rise in temperature.

Subsequent discussion deals with the chemical nature of cracked products and their treatment. An interesting discussion on the hydrogenation of petroleum products is given in the last chapter.

The work as a whole represents considerable research and although the conclusions and interpretations may not be entirely admitted, these will prove informative.

Geology of Natural Gas.—Edited by Henry A. Ley; published 1935 by American Association of Petroleum Geologists, Tulsa, Okla. 1227 pages, 250 illustrations. $6.00.

This monumental volume is the outcome of a proposition put forward by Frederick H. Lahee and the late Sidney Powers that a book be prepared and published on the geology of natural gas; their proposal was approved by the A.P.I. and has been executed under the editorship of Mr. Ley.

The body of the work is made up of 38 separate papers, each relating to a particular field (North American gas fields only are treated) and each is written by one or more men having familiarity with that field. In arranging his material the editor proceeds from north to south; that is, papers relating to Canada come first, then the northern and southern United States, Mexico, etc. In treating his field each author has outlined, within the limits of his available space, what is worth knowing about its general and special geology, and has incorporated such pertinent economic, engineering and statistical information as has been available. The treatment is mostly factual, with little emphasis on theory. At the end of the book are four general papers: One on the valuation of natural gas properties, by Eugene A. Stephenson; one on estimation of natural gas reserves, by P. McDonald Biddison; and one on the geology of natural gases rich in helium, nitrogen, carbon dioxide and hydrogen sulphide; the closing paper "Natural Gas," by Henry A. Ley, is a general discussion of the uses and economics of natural gas. The paper by Stephenson on valuation of natural gas reserves and the paper by Biddison on estimation of natural gas reserves are especially noteworthy, as they deal with a subject on which little systematic information has been available to all petroleum geologists.

La Interpretacion Geologica de las Mediciones Geofisicas Aplicadas a la Prospeccion (the Geological Interpretation of Geophysical Measurements as Applied to Prospecting). By José G. Sineriz, Instituto Geológico y Minero de Espana, Madrid. 1933. 534 pp., 37 Pls., 25 Pesetas.

The present work is particularly valuable inasmuch as it deals with the most important phase of geophysical prospecting, namely the interpretation of the measurements. The investigations were carried out in Spain under the auspices of the Geological Institute and consist first of seismic interpretations as applied to correlation of structural conditions and secondly their further confirmation by gravimetric methods.

Under the able direction of the author many innovations of merit were resorted to with considerable success, such as the determination of a geological horizon located beneath one of greater propagation velocity, the author's method of registering the instant of explosion and likewise his method of determining the approximate depth of under-strata by the "coefficient of depth" and many others which will be found of great interest.

The seismic investigations prompted the further study of certain regions, in particular in order to confirm the existence of petroleum deposits. The results and interpretations from these studies precluded the presence of oil in commercial quantities and drilling was therefore not carried out.

The entire work was admirably conceived and executed and this thorough and extensive report is a scholarly and practical contribution to this science.

Electric Condenser Process for Demulsifying Oil.—R. J. Piersol. Illinois Geological Survey, Report of Investigations No. 29.

The research here reported was undertaken in an attempt to develop and test the effectiveness of an electrical process for demulsifying oil to meet the needs of the oil operators in Illinois where the amount of cut oil to be treated at each point of collection averages 15 bbl. per day, and where most leases are not served by electric power lines. A process was developed to meet the problem and a small field unit has been constructed with capacity of one barrel per hour. The equipment is rugged and its operation requires no technical skill. A complete bibliography on the literature and patents for electrical demulsifying of oils is appended.

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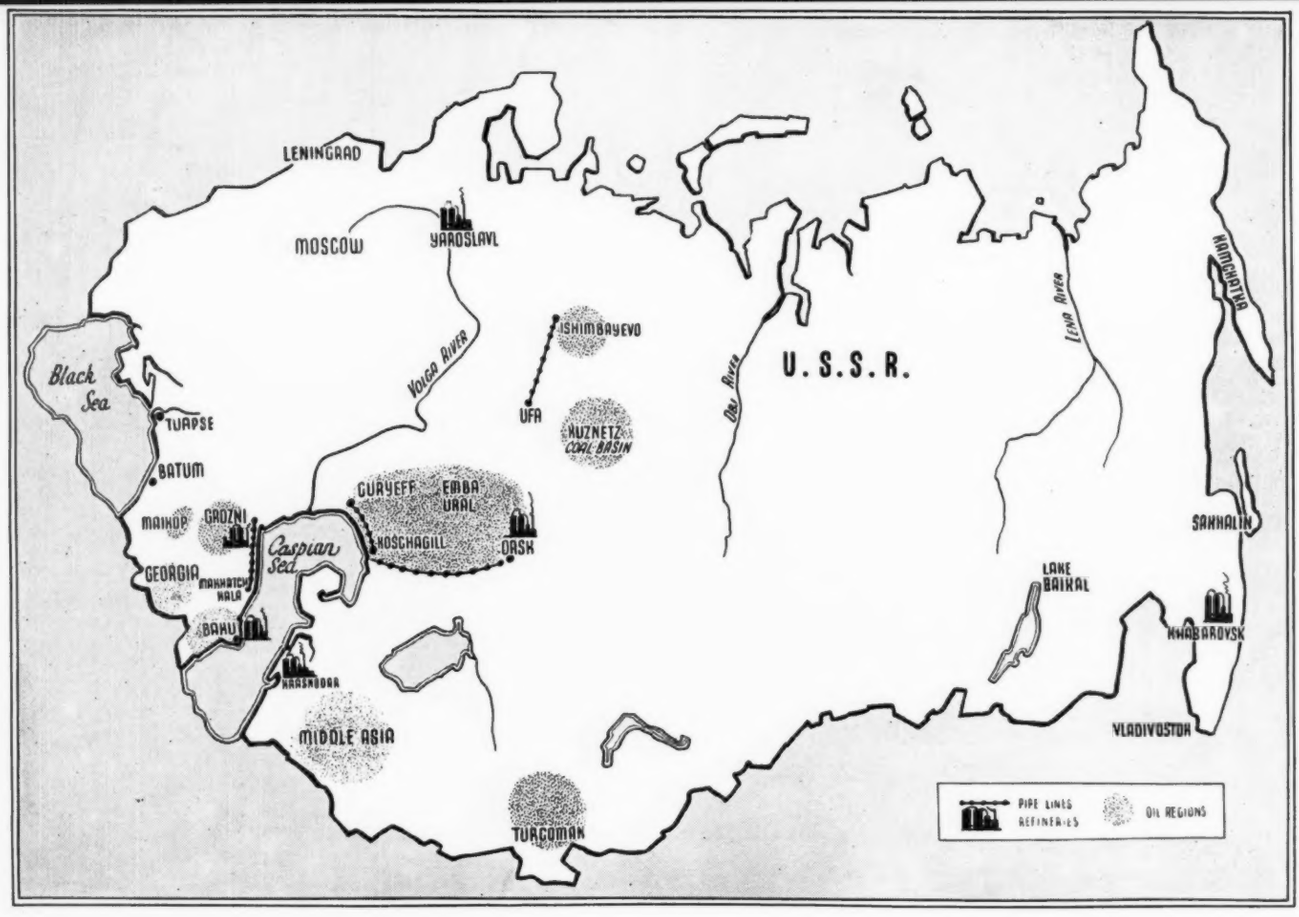


Map showing principal oil regions discussed in Prof. Gubkin's estimate of Soviet oil resources and the location of refineries and pipelines that have been ordered completed by the end of this year by the Council of People's Commissars.

U. S. S. R.

1935	Crude Production (bbl.)	Daily Average (bbl.)	Run to Stills (bbl.)	Drilling (feet)
January	13,358,000	430,935	11,400,000	248,672
February	12,704,300	453,725	10,909,500	334,000
March	14,139,300	456,107	11,714,000	449,417
April	14,058,200	468,609	11,350,000	431,050
May	14,280,000	476,000	11,880,000	442,050
June	14,150,000	471,700	11,750,000	448,500
July	14,050,000	453,226	11,630,000	449,750
Total Seven Months 1935	96,739,800	456,320	80,633,500	2,803,439
Total Seven Months 1934	97,137,000	453,912	84,406,000	2,524,374
Total 1934	168,648,700	458,042	145,141,000	4,122,898
Quota 1934	214,900,000	585,879	161,000,000	4,950,000
Quota 1935	232,400,000*	636,700	171,500,000	5,214,000

* Including gas; except gas, 198,800,000 bbl. of crude

Crude conversion: Seven bbl. = one ton

THERE was no noticeable improvement in Soviet oil production during July. The entire group of Soviet fields, including Baku, were operating behind schedule. On the basis of figures available for the first half of July, production for the month would not reach more than 80 percent of the July quota, whereas in June the quota was fulfilled 88 percent. Baku was the main cause of this decrease, as production there fell to 80 percent of plan estimates. Grozni and Maikop produced 85 and 92 percent of their quotas, respectively. The outlook for the next month held little encouragement; July being an unfavorable month for operations owing to the heat and approaching vacation periods.

The percentage of the year's plan fulfilled during the first six months of 1935 in the oil industry has been less than in any other branch of Soviet Heavy Industries, as is shown in the accompanying table.

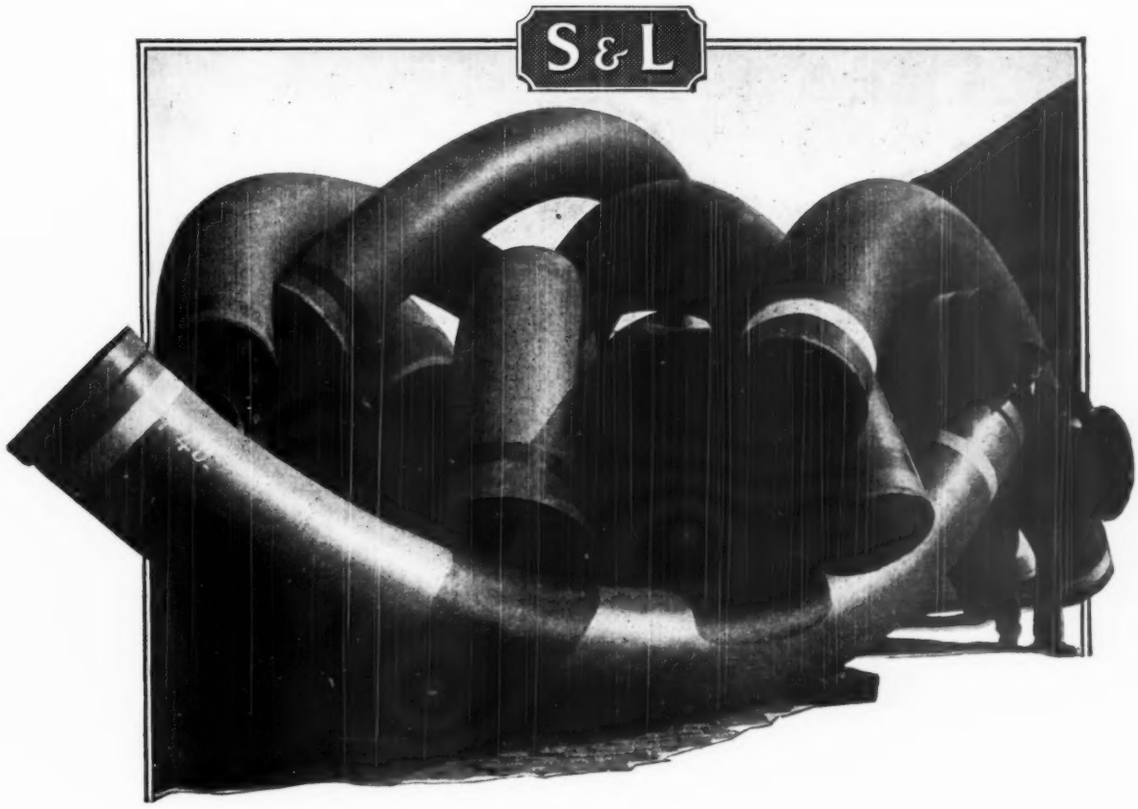
Percentage of Plan Fulfillment for Various Soviet Industries

Oil	42.2	40.8
Coal	45.4	46.6
Steel	50.0	45.8
Coke	48.3	48.9
Pig Iron	48.0	49.1
Motor Trucks	44.9	46.9
Combines	63.6	37.6

Baku oil fields are 9,212,000 bbl. of crude behind schedule, and of all the groups in Baku only the Kiroff and Ordzonikidze fields have thus far kept up to plans for production and drilling. All other fields fell behind, both in oil produced and drilling of new wells. The Stalin group of Baku which includes the Ilyitch Bay field, made the poorest showing. Total production of this group averages about 8,500 bbl. per day, of which Ilyitch Bay produces about 6,000 bbl., while there are about 2,250 wells which produce only one barrel each per day.

The general position of operation at all Soviet oil fields is reported as follows:

Baku: Below normal and falling behind



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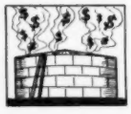

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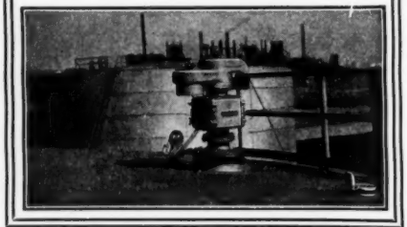

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steadily. Drilling results low and insufficient new wells completed for operation.

Grozni: Some improvement effected by Molgabek, otherwise no changes and generally below objective production.

Maikop: Statistically above operations at Baku and Grozni. Rate of drilling, however, is low and summarily below plan.

Emba: Drilling generally improved but production below expectation.

Vostokneft: After several failures in drilling, operations were concentrated at Bashkiria.

Turcomanneft: Production has increased from about 11,000 bbl. in January to 230,000 bbl. per month at present. Several gushers were opened and the plan for the entire year 1935 was completed in June.

Middleasia: No changes have taken place. Drilling proceeds slowly owing to lack of equipment and supplies.

Sakhalin: No important changes. The field produces between 122,000 and 140,000 bbl. of crude per month.

The plan for crude production, including gas, for 1935 has been revised from 232,800,000 bbl. to 212,310,000 bbl. Production of crude and gas for the first six months of 1935 totaled 89,690,000 bbl. and orders were issued to produce during the third quarter (July-August-September) 60,040,000 bbl., and during the fourth quarter 62,580,000 bbl., or altogether 122,620,000 bbl. for the remaining six months, a total of 212,310,000 bbl. for the year. This revision means a decrease of 20,490,000 bbl. in the required production.

At a special Conference of the Azerbaidzan Regional Communist party, decentralization of the Azneft Production Trust was accepted as necessary for efficient management and operation, due to the enormous growth of the Baku fields. The fields which were formerly unified under Peterson were split up into four separate units, embracing 48 divisions for production and 17 groups for drilling. The four newly formed Baku units are: (1) Lenin Production Trust, (2) Asisbekoff Production Trust, (3) Ordzonikidze Production Trust and (4) Stalin Production Trust. Azneft no longer exists.

The underlying reason for this decentralization was the difficulty encountered in trying to manage Baku from a centralized institution. The central management was in no position to keep pace with the expanding needs of individual local fields and wells. As a consequence, sufficient attention was not given to all the details of drilling, production, etc., and the results were frequent breakdowns at wells or disorganization of operations. About two years ago Baku oil fields underwent a reorganization, when all the refineries were separated from production and a special refining trust was created under S. Slutzki. The operations of 1934 have shown that this reorganization was a great success and it has been decided to go on further with the decentralization.

The Council of People's Commissars of U.S.S.R. has decreed that the refineries indicated in the accompanying table shall be completed and start operations during 1935.

In addition, there are three pipelines to be completed; one from Orsk to the Caspian Sea, capacity 3,500,000 bbl. per year, another from Koschagil field to Guryeff, capacity 3,500,000 bbl. per year, and the Makhatch Kala-Grozni line, capacity 10,500,000 bbl. per year.

Soviet Refineries to Be Completed in 1935

Number	Type of Refinery	Location	Capacity in bbl. per year
4	Cracking	Saratoff	4,200,000
4	Cracking	Grozni	4,200,000
4	Cracking	Baku	3,360,000
1	Cracking	Khabarovsk	1,400,000
1	Cracking	Yaroslavl	1,050,000
4	Pipe Still	Baku	35,000,000
1	Distillation	Yaroslavl	840,000
1	Pipe Still	Orsk	3,500,000

Wells to Be Completed During 1935

Oil Fields	Total for 1935	Completed first 5 months 1935
Baku	882	234
Grozni	204	72
Emba	30	15
Maikop	54	16
Vostokneft	36	6
Middleasia	29	12
Sakhalin	45	4
Total	1,280	359

Soviet Oil Resources

RUSSIA of prewar days always had a shortage of fuel and it was generally believed that the country's industrial development would be retarded until sufficient fuel resources could be established. Russian economists were of the opinion that about two thirds of the country's fuel requirements were available in coal and vegetable combustibles, such as wood, straw, peat, etc., and approximately one third of the total requirements were imported in coal from England, Belgium, etc. On the eve of the world war the fuel shortage became critical and prices jumped 75 percent above world markets.

Prewar estimates had placed Russia's coal deposits at 60,000,000,000 tons. This was revised recently by Soviet geologists and increased to 1,200,000,000,000 tons. Prof. I. Gubkin has made an extensive geological survey of the Soviet coal resources and has moved Russia into second place after the United States. No estimates of Russia's oil deposits were made prior to 1922 when the total of all fields was placed at 5,400,000,000 bbl. During the First Piatiletka, however, Prof. I. Gubkin revised the figure to 21,000,000,000 bbl., or about one third of the total for the world, thus bringing the Soviet Union into first place.

Prof. Gubkin believes one half of the total to consist of deposits immediately available and he places 10,500,000,000 bbl. of oil deposits in the following categories: Explored Deposits (A) 1,155,000,000 bbl.; Visible Deposits (B) 315,000,000 bbl.; Expected Deposits (C) 1,925,000,000 bbl.; Possible Deposits (D) 7,105,000,000 bbl.; or a total of 10,500,000,000 bbl.

The two groups A and B amounting to 1,470,000,000 bbl. are immediately available, in his opinion and there is a further likelihood that prospecting and exploration will uncover more deeply situated horizons which would considerably enlarge these two categories. Mr. Gubkin also expects the other two categories to be shifted into higher position by

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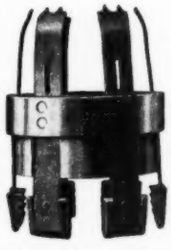

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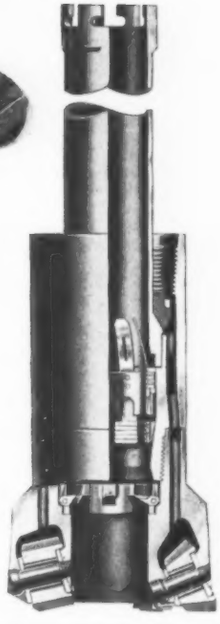

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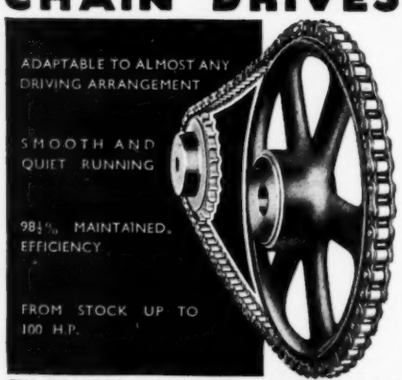
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adequate drilling and prospecting. The most recent estimates cover the following areas:

Estimates and Location of Soviet Reserves

Area	Estimated Deposits in bbl.
Baku	9,275,000,000
Emba-Ural	4,480,000,000
Middleasia	1,680,000,000
Grozni	980,000,000
Maikop	560,000,000
Ishimbayevo	420,000,000

Oil deposits were discovered at various points in the Soviet Union from the northern extremity at Petchora-Taimir, on the shores of the Lena river, down to the southern regions of Georgia and Middleasia, and from the Volga plains over the Urals to Siberia, the Baikal lake and the Far East at Sakhalin and Kamchatka. (See map on page 544.)

Addressing a recent Soviet Conference of Petroleum Geologists, Prof. Gubkin asserted that Soviet oil operators are not yet able to take advantage of deep reserves. At Karachukur, Kala (a recent discovery) and elsewhere in Baku prolific oil formations which will yield light crude are to be found at greater depths than are operated at present. Pirsagat (Aliati district), Miadjaisk (Kabristan meadows) and Kizil Tepe, which have been under exploration since 1934, will likewise require deep drilling.

The deeper productive strata at Grozni have not been tapped as yet. The complicated characteristics of the subsoil formations under study have been formulated as broken, faulty and overthrust in the form known to the Soviet geologists as Podnadvig. During the past four years several attempts were made to master this Podnadvig, without any appreciable success, however, owing to new methods of drilling required. It is, therefore, evident that the deep layers at both Baku and Grozni still offer some difficulties. It has been admitted by Soviet geologists of Gubkin's rank that while the deeper oil strata of the Apsheron peninsula have been more or less contoured, no such operations have been undertaken at Grozni. At Molgabek, three structures together with the XVII. horizon were opened for production in 1933. The upper formations contain a heavier grade of crude and the lower formations contain light crude with 40 percent gasoline and kerosene.

MAIKOP: This Soviet oil field is the third largest after Baku and Grozni. The geology of Maikop is of an original and rather difficult nature. Innumerable explosions and other irregularities of production in 1931 and 1932 have hampered progress for a long time. Today, however, Maikop produces some 20,000 bbl. of crude per day and production could be doubled under adequate supervision. In 1933 prospecting carried on at Apsheronsk and Khadizensk established a firm link connecting both regions into one oil field. Today Maikop has one of the deepest oil wells on record (6,500 ft.) in Soviet fields. Apsheron crude is of a light grade containing some 40 percent of gasoline and the Maikop gases are suitable for absorption into a high grade of aviation fuel, and they also contain propane and butane. The immediate prospecting plans of Maikop

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are centered at Kutais where the crude is reported to contain about 60 percent of light fractions. Operations were recently also extended to Khadizi, along the northeastern incline of the Caucasian mountains, embracing there a group of hills known as asphalt hills where signs of bitum and liquid crude were found. It is also likely that the northwestern line of the Caucasian mountains at Kutais down to the Azov sea has the same properties. Some of the formations were found to be of tertiary and some of mezozoic characteristics.

URAL EMBA: In the southern regions of this vast area over 300 salt domes are known. Of these only 17 domes have been explored, at Makat and Dossor. Several wells were drilled recently at South Iskine and Koschagil in the northern regions, as well as at Temir, Shubar Kudak and Djaksi. The Emba region forms a desert or semi-desert, and the nearest point of civilization is 500 miles away at Uralsk. The desert as well as the semi-desert lands are devoid of water, vegetation and roads. The population consists of nomadic tribes and is very sparse Recent geological data reveals that Emba's sal tectonic extends far beyond the line of the Volga river, and at the right bank of the river signs of oil were found scattered over an area of no less than several hundred miles.

MIDDLEASIA: This territory covers an area half the size of all western Europe. So far, only the Feghana valley has yielded quantities of oil from several small and badly faulted underground folds. All in all, some 60 structures were explored and also contoured in recent years, but all of these structures require deep drilling. Neftdag, in the adjacent regions of Turcomania, which has become famous for its gushers of 1931 and 1932, is reported to hold not less than 70,000,000 bbl. of crude exclusive of lower strata not yet explored. Haudag, which is about 1,000 kilometers from the original discovery, is another promising area and it is very likely that the entire Ferghana valley will represent an oil field of imposing possibilities in the future.

TURCOMANIA: Bordering on the region which encloses Neftdag in Middleasia, this area holds more future reserves. Boyakent and Monjukli at Chikishliar, between Krasnovodsk and the Persian frontier line, were explored recently and found of commercial value.

GEORGIA: Over 60 structures have been under geological studies and 27 layers, at Shiraki and Mirsaani, covering a width of about 2,000 meters, are already considered productive. The folds are generally broken and overthrust by other formations. Drilling proceeds slowly and is of poor quality, owing to adverse climatic and other conditions which make operations difficult.

A new petroleum field was discovered in the Urals, during the past two years. Ishimbayevo, about 140 kilometers from Ufa is at present connected with Ufa by a railroad and a pipeline is under construction. This field has been created by recommendation of J. Stalin in line with his desire to create an independent oil base in the east for reasons of defense. S. Ganshin, former head of Glavneft and at present manager of Vostokneft, recently made the following statement:

"The geographical chart of Soviet oil fields is being redrawn. From the Caspian to the north of the country over the extensive plains of Kazakstan, Emba, Orenburg, Bashkiria and the Tartar territory, huge oil deposits have been discovered. Ishimbayevo is situated at a central point to all these new areas and geological studies have shown that the entire area is of oil bearing properties, just as the territory enclosed between the west and south of the Urals. Of course, it will require some effort to make a commercial success of these fields, but the failures of the past, as at Chussovo village, have pointed out to us the reasons for our past failures. We have learned not to repeat our mistakes and believe we now hold the key to success. Since the discovery of Chussovo in 1929, some 19 regions of the Urals have been under exploration, but oil of commercial value has been found so far at Ishimbayevo only. All others were abandoned as not suitable for operation. At Ishimbayevo about 14 correlations were discovered which indicate favorable oil formations over a large area, including Kuspiakulovo and Allagutovo. At depths of 2,900–3,000 feet oil saturated clay was found on the wings of the formations which hold large oil deposits of commercial value."

The southern part of the western incline of the Urals, and possibly the northern part of the same incline, seems to be suitable for geological exploration. Ishimbayevo is expected to produce 3,500,000 bbl. of crude in 1935, about 7,000,000 bbl. in 1936 and about 10,500,000 bbl. of crude in 1937. The crude is of a light grade containing some 30 percent of lignt products and the gasoline is of an E.B.P. of 392 deg. F., but the crude contains over three percent of sulphur and its refining is something entirely new for Soviet conditions. Ishimbayevo is short of equipment. Of about 80 drilling outfits required for immediate operations only 27 units will probably be supplied in 1935. Housing is an acute problem for the field.

KUZNETZK COAL BASIN: Oil has recently been discovered in the Barsaask region of the Kuznetzk coal basin. The region is situated on the western slope of the Kuznetzk Alatan promontory and borders on the Kuznetzk coal basin. A geological survey of the formations shows that the strata are of more or less even distribution and are rather centered in dome form tectonic. In 1927 the Krapivinski anticline was reported to contain large quantities of asphaltite and in 1932, based upon more scientific research, Prof. Gubkin has indicated the possibility of oil deposits in the Kuznetzk coal basin and has strongly recommended including an oil expedition in the Geological-Hydro-Geodesical Service which has been prospecting for coal in Western Siberia. The asphaltites discovered contain also gases which are 70 percent methane, 2.5 percent hydrogen and the balance consisting of carbon oxyde together with oxygen and nitrogen. At a depth of about 400 ft. liquid bitumen and oil were discovered.

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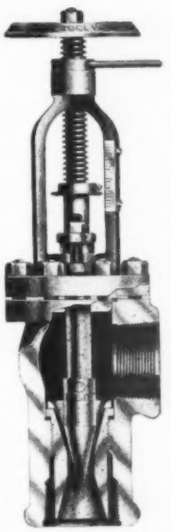

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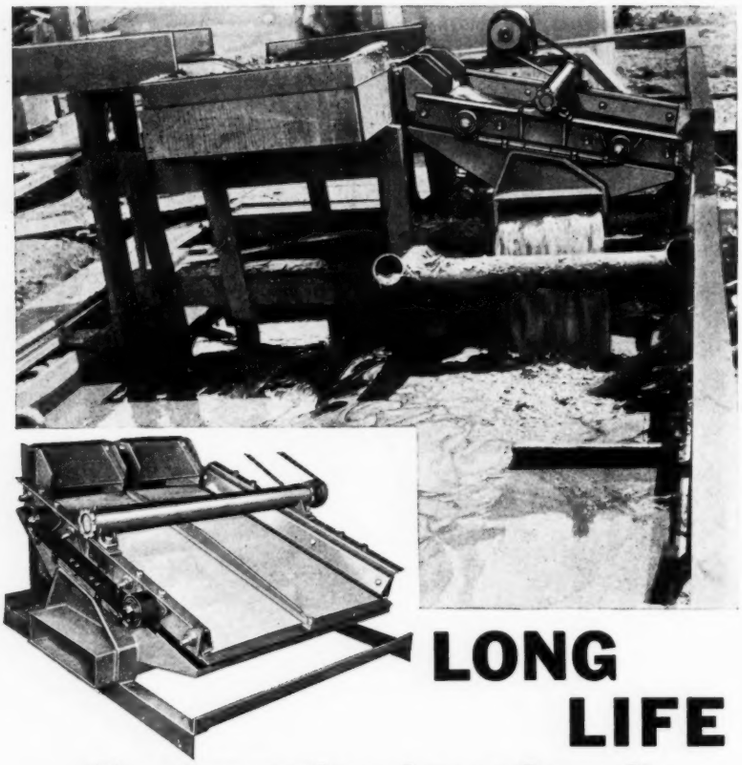

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M. Barinoff commenting on the oil estimates of Prof. Gubkin believes that the figure of 21,000,000,000 bbl. does not include all possible resources contained in Siberia, Volga plains, Lake Baikal and elsewhere. M. Barinoff suggests a revision of the geological findings of Prof. Gubkin with a view to shifting all categories of possible and visible deposits into immediately available resources and to begin with their development as soon as possible.

An international Geological Congress in 1937 is expected to take place in Moscow. Prof. Gubkin believes that Soviet geologists will be able to justify before the Congress the challenge for the first place in petroleum resources.

J. WEGRIN

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OUR front cover picture this month shows drilling in the Fitts pool in southeastern Oklahoma, one of the most active drilling spots in that state.

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